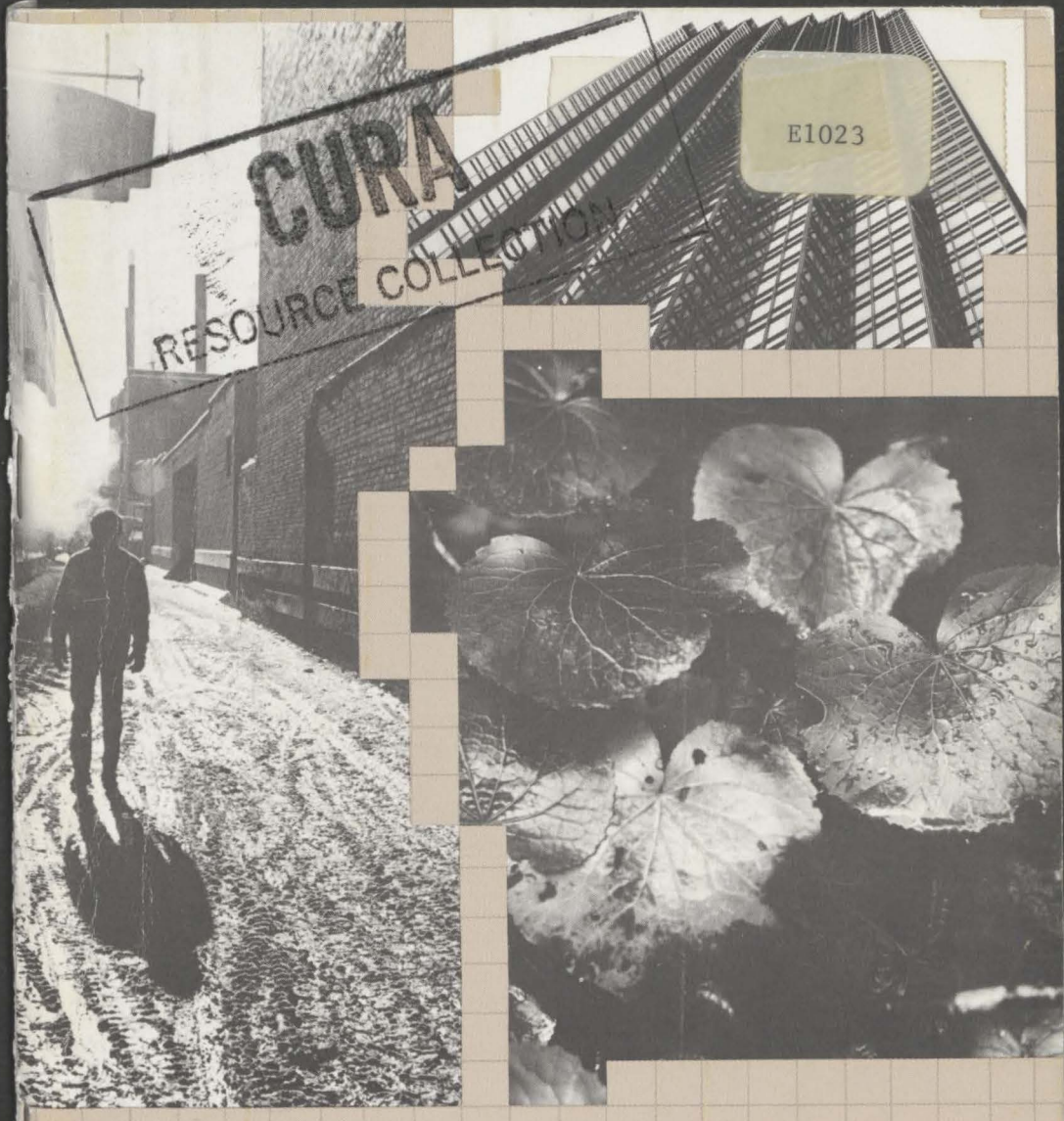




University of Minnesota

# Courses and Programs in the Environment

1978-80

*Prepared by:* Mary Trigg
Lorna McKeen

*Photos courtesy of:* Minnesota Department of Natural Resources,
Jill and Ken Greer

*Cover photos:* Jill and Ken Greer

All-University Council on Environmental Quality
Center for Urban and Regional Affairs
University of Minnesota
967 Social Sciences Building
Minneapolis, Minnesota 55455

# A STUDENT GUIDE TO COURSES AND PROGRAMS IN THE ENVIRONMENT

1978-80

UNIVERSITY OF MINNESOTA

# CONTENTS



**Course Numbering**

1000 to 1998— open to freshman and sophomores

3000 to 3998— open to juniors and seniors

5000 to 5998— open to juniors, seniors, and graduate students

8000 to 8998— open to graduate students only

A final digit "0" identifies courses that may be repeated.
The number "970" indicates "directed study."

**Course Abbreviations and Symbols**

Departmental prefix—abbreviation indicating name of department (e.g., Geog for Geography)

Course number—four digit figure denoting the course (e.g., 5002)

*— courses in which graduate students may prepare Plan B projects

†—all courses preceding dagger must be completed before credit will be granted for any quarter of the sequence

§—credit will not be granted if equivalent course listed after section mark has been taken for credit

¶—concurrent registration allowed with course listed after paragraph mark

#—consent of instructor is required for registration

△—consent of department of school offering the course is required for registration

f,w,s,su—following a course number indicate fall, winter, spring, or summer quarters

Students should consult the Class Schedule each quarter to learn the hour and place specific courses are offered.

# Courses and Programs in the Environment

## I. GENERAL INFORMATION

The term "environment" is one that is used frequently these days. Increasing numbers of jobs are related to environmental quality, and many students are becoming interested in pursuing environmental courses and training.

Since 1971, the All-University Council on Environmental Quality at the University of Minnesota has prepared a bulletin of environmental courses and programs (revised every two years) to aid students in selecting environmental courses. In 1974, the bulletin was expanded to include courses and programs in planning and urban studies. This year the council has returned to preparing a summary of environmental courses and programs only.

In the broadest sense, a very large number of the courses and programs at the University have implications for environmental quality. It was necessary, however, to set some limits on what would be included in this student guide. There is no environmental studies department at the University and no formal undergraduate or graduate degree program in environmental studies. However, there are programs, such as Individually Designed Interdepartmental Majors in the College of Liberal Arts and University College, in which students can design their own environmental studies major. And several units offer programs that include a primary concentration on the environment.

This guide is designed to help students become familiar with courses that are related to environmental issues; to provide information on environmental programs, centers, and libraries; and to provide names of people in each department whom students may contact for further information on environmental courses and programs.

Section II contains information on courses and programs on the Twin Cities campus. Preceding the course listing is a subject index to help you find courses related to a specific area of interest. Following sections describe programs and courses at the Duluth, Morris, Crookston, and Waseca campuses.

## DO YOU NEED HELP?

Students are often bewildered by the many departments, programs, centers, and other units at the University. Since there is no department of environmental studies, there is no one place to go to get information on questions pertaining to environmental courses, programs, and jobs. You may be asking yourself the following questions and not know where to go to find the answers.

Where do I go to get financial aid?

Many colleges and departments offer financial aid to students. Loans, scholarships, or grants may be available. Students should contact individual departments or colleges for further information or contact the Student Financial Aid offices at: 107 Armory Building, 373-4021 (Minneapolis) or 190 Coffey Hall, 373-1197 (St. Paul).

Do I qualify for a student internship?

Student internships are required for graduation in some departments and are available for interested students in others. Check with your departmental or college office or the contact person listed in this guide.

Can I take an independent study course for credit?

Students often wish to study on their own rather than in the usual classroom setting. Credit for independent study is available in many departments. More information may be obtained from the contacts listed with each department in this guide.

How do I get a job after graduation?

Students have become increasingly concerned about employment after graduation. The number of jobs related to environmental quality is growing. Many departments and colleges offer career counseling or placement service for graduating students. Some departmental offices post job descriptions. Be sure to check with individual units for information on available jobs.

For additional information about these and other questions, contact the Campus Assistance Center at 373-1234. Their phone is answered 24 hours a day.

# II. TWIN CITIES CAMPUS

## Environmental Programs

### INSTITUTE OF AGRICULTURE, FORESTRY, AND HOME ECONOMICS

The institute is composed of the Colleges of Agriculture, Forestry, and Home Economics; the Minnesota Agricultural Experiment Station; the Minnesota Agricultural Extension Service; and the Office of International Agricultural Programs. The institute supports the teaching, research, and extension programs of these units but does not offer a degree program itself.

### COLLEGE OF AGRICULTURE

Agricultural science deals with the interrelationships of people and their environment in the areas of conservation, food production, environmental design, and environmental management. Students examine the relationships between air, water, plants, animals, soils, and humans in natural and modified environments. Graduates have been employed in educational, management, and planning positions with governmental agencies and private businesses involved in resource and environmental management.

The College of Agriculture comprises six curricular areas in which 22 majors are offered. The college's degree programs are administered through its 12 departments. Programs with an environmental focus are described briefly below, by department or curricular area.

**Department of Agricultural Engineering**—The Department of Agricultural Engineering offers two degree programs directly concerned with environmental problems. One program, offered jointly with the Institute of Technology, leads to the bachelor of agricultural engineering degree and provides opportunity for specialization in the areas of soil and water management and/or agricultural waste management (see Institute of Technology Bulletin).

The second program leads to the bachelor of science degree with a major in soil and water resource management. While this major is administered by this department, study for it is outlined in the resource and community development curriculum (see College of Agriculture Bulletin).

For more information about these programs, contact C. L. Larson, 207 Agricultural Engineering, 373-1331.

**Department of Entomology, Fisheries, and Wildlife**—The degree programs in entomology, fisheries, and wildlife are designed to provide students with the basic training in the biological and physical sciences and related disciplines necessary for work in these professional fields. For further information, see the college bulletin or contact L. D. Frenzel, 143 Hodson Hall, 373-1715; or T. F. Waters, 120 Hodson Hall, 373-1706. Students interested in insect ecology should contact E. F. Cook, 316 Hodson Hall, 373-1721.

**Department of Horticultural Science**—The Department of Horticultural Science and the School of Architecture and Landscape Architecture jointly sponsor programs in landscape architecture. These programs are briefly described in this bulletin under Architecture and Landscape Architecture and are outlined completely in the College of Agriculture Bulletin. More information can be obtained from Peter Olin, 422 Alderman Hall, 373-1663.

**Department of Soil Science**—Students majoring in soil science may pursue an environmental emphasis in their program by choosing courses offered within the

department that are of direct environmental interest. These courses are listed in this bulletin and also in the College of Agriculture Bulletin. For more information, contact Russell S. Adams, Jr., 125 Soil Science, 373-1361.

**Resource and Community Development**—This curricular area offers programs of study leading to a bachelor's degree in either the College of Agriculture or the College of Forestry. Majors are presently available in landscape architecture, recreation resource management, resource economics, economics of public services, and soil and water resource management. For more information, consult the College of Forestry Bulletin and the College of Agriculture Bulletin or contact D. B. White, 456 Alderman Hall, 373-1609.

## COLLEGE OF BIOLOGICAL SCIENCES

The departments and program units in the College of Biological Sciences include: biochemistry, biology, botany, ecology and behavioral biology, and genetics and cell biology. The college is also administratively responsible for the Lake Itasca Forestry and Biological Station, the Cedar Creek Natural History Area, the James Ford Bell Museum of Natural History, the Freshwater Biological Institute, and the Dight Institute of Human Genetics. Detailed program information can be found in the College of Biological Sciences Bulletin. Each department of the college offers an independent study course option. For additional information, contact the director of student services, 223 Snyder Hall, 373-3648.

## COLLEGE OF EDUCATION

The College of Education offers some opportunity for students to prepare to teach environmentally related courses and programs. Portions of methods courses and workshops in biological education, social studies education, and elementary education are devoted to certain aspects of environmental studies.

## COLLEGE OF FORESTRY

Programs in the College of Forestry are designed to provide students with the broad foundation in the biological and physical sciences and other disciplines necessary for understanding and managing our forest resources. Opportunities for specialization are available in the Departments of Forest Resources and Forest Products. For further information, consult the college bulletin of contact Ken E. Winsness, 12 Green Hall, 373-0842.

**Forestry Technician Course**—This program, a joint venture of the college and the University's North Central School and Experiment Station at Grand Rapids, Minnesota, was begun in 1958. The intensive course work, which is offered at Grand Rapids, consists of 960 hours of instruction in both classroom and field laboratory, and is divided into 2 terms of 3 months each. The first term is held from October through December, the second from January through March. For further information, contact William Matalamaki, Superintendent, North Central School and Experiment Station, Grand Rapids, Minnesota 55744.

## GENERAL COLLEGE

The General College offers in a course package a problem-centered, team-taught, interdisciplinary study of environmental problems. This package lasts 1 academic quarter and is taught via field studies, seminars, field trips, and formal

contact between students and staff. Course work emphasizes individual and small group off-campus investigation and reporting. Approximately 40 students may register for 16 credits in the four courses that constitute the package: GC 1921, 1922, 1923, and 1924. The credits are split among the natural sciences, social sciences, communications, and humanities.

More information can be obtained from A. B. Johnson, 113 Folwell Hall, 373-3723 or 373-3719.

## HEALTH SCIENCES

**Environmental Health**—The programs in environmental health have been offered in the School of Public Health since 1935. They are designed to cover the many health aspects of environmental control and to develop broad-based knowledge to prepare graduate students for responsible planning and direction of environmental programs. Programs of graduate study leading to the M.P.H. (master of public health), M.S., and Ph.D. degrees are available. The course of instruction leading to a master's degree requires a minimum of 11 months of study, beginning with the fall quarter. Course work is available in such areas as air pollution, institutional environmental health, radiological health, occupational health, water hygiene, liquid and solid wastes, food hygiene, environmental biology and microbiology, injury control, administration, and general sanitation. Students may either specialize in a particular topic area of make a broad selection from all the courses available.

For more information, consult the Graduate School Bulletin, the School of Public Health Bulletin, or Rexford D. Singer, 1160 Mayo, 373-8080.

**Family Planning Administration**—Family planning and population studies require skills and expertise from many disciplines. A broad range of University resources—clinical, laboratory, and didactic—is available for teaching these skills. This graduate program, which leads to a master's degree in family planning and population studies, brings together such resources from the Department of Obstetrics and Gynecology, the Medical School, the School of Public Health, the Department of Sociology, and other units of the University. The program is designed to train personnel to establish, administer, and operate family planning programs as well as to prepare individuals to administer individual programs such as those that are part of OEO-funded community action agencies, HEW-funded agencies, Planned Parenthood affiliates, etc. In addition, the program is designed to meet the needs of students who wish to pursue careers in family planning research. The courses developed to meet the needs of this program are open to other interested students who find the course content useful for their disciplines.

More information on this program can be obtained from Harry Foreman, 12-186 Health Sciences Unit A, 373-9656.

**Department of Pharmacology**—The graduate program of the Department of Pharmacology enables students to investigate certain aspects of toxicology. In many instances this investigation of research problems may be directly concerned with environmental problems. For information about the pharmacology graduate program, contact Frederick E. Shideman, 105 Millard Hall, 373-3085.

## COLLEGE OF HOME ECONOMICS

Much of the subject matter in the broad field of home economics deals with aspects of the near environment of individuals and families: shelter and furnishings, food and nutrition, clothing and textiles, and the social environment created through human relationships.

Undergraduate programs in the college are interdepartmental in nature and provide opportunities for students with special interests in environmental problems. Students may develop a concentration with an emphasis on environmental issues, concerns, policy as part of the usual B.S. degree requirements for some of the

college programs (i.e., consumer food science, general home economics, family relationships, housing, or textiles and clothing).

Internships, field experiences, or directed study courses are part of each of the 13 undergraduate program curricula in the College of Home Economics. Students who wish to explore off-campus study as a means of earning degree credits and career opportunities after graduation are encouraged to contact the director of career planning and placement in 32 McNeal Hall, 373-0935.

Specific courses dealing with aspects of the environment are offered in the College of Home Economics by the Departments of Design, Family Social Science, Food Science and Nutrition, and Textiles and Clothing. More detailed information may be obtained from Natalie Gallagher, director of student services, or other staff in the college office, 32 McNeal Hall, 373-0933.

**Housing Program**—The undergraduate program in housing provides a multidisciplinary sequence of educational experiences in the study of family and individual needs and problems. Building upon courses offered within the College of Home Economics and pertinent courses offered by other units of the University, the curriculum provides a choice of three options: business and commerce, social service, and design. Within each option students may direct their choices toward specific career requirements. In addition, by careful planning of the collateral sequence, field experiences, and free electives, students may acquire further depth in a particular area of interest.

Students graduating from this program may work with public agencies concerned with housing at the local, state, or federal level; with private companies; with utility companies; or with design firms or contractors. The social service option is designed to prepare students for community service in housing relocation. Specific requirements for this program are outlined in the college bulletin, and further inquiry can be made of Evelyn Franklin, 246f McNeal Hall, 373-1769.

## COLLEGE OF LIBERAL ARTS (CLA)

**Bachelor of Individualized Studies**—Students interested in environmental studies may include such course work in a bachelor of individualized studies (B.I.S.) program. To earn this degree, students propose coherent individualized programs based on personal academic objectives, which need not be confined to a single area of concentration. Proposals must be evaluated and approved by at least two faculty advisers. The degree is in an experimental phase, and enrollments are limited. Further information is available in 302 Wesbrook Hall. At the time of publication of this guide the B.I.S. degree was awaiting final approval.

**Department of Geography**—This department provides a program for geography majors who wish to orient their program toward studies of the physical environment. For further information, consult Professors Barrett, Brown, Gersmehl, Skaggs, Squires, or Tuan through the departmental office, 414 Social Sciences Building, 373-2661.

**Individually Designed Interdepartmental Majors**—Students who wish to design a major program in an environmental area may do so by consulting an adviser in the interdepartmental majors office. Course work for such majors, leading to the B.A. degree, is interdisciplinary in nature. These majors resemble formalized major sequences in balance, unity, and areas of concentration, but cut across departmental lines and usually require more credits. The degree requirements are substantially the same as those for other B.A. programs in CLA.

Illustrative of the kind of program that might be devised, for example, is one that would combine courses in such life sciences as biology, ecology, and zoology with courses in other disciplines such as anthropology, chemistry, and geography. A major program focusing on the environment and society might include work in the life sciences, anthropology, geography, and the social sciences.

Additional information may be obtained from the Office for Interdepartmental Majors and Programs, 302 Wesbrook Hall, 376-3030.

**Institute of Public Affairs**—A program in technology planning exists within the Hubert H. Humphrey Institute of Public Affairs. Students pursuing a master of arts degree with a major in public affairs may choose a concentration in technology planning with emphasis on environmental policy. The master of arts curriculum in public affairs consists of an internship and 54 credits of graduate work, the latter composed of required courses (18 credits), two areas of concentration (at least 12 credits each), and electives. Students work under the Plan B (no thesis) option.

The technology planning program is based on the realization that technological innovation is one of the major forces in the restructuring of society, that new technologies frequently carry with them profound social and environmental change, and that effective accommodation to such change is a vital part of the policy process. Accepting this and assuming that a traditional function of the University is to serve as a societal monitor, the program is structured to include: research on the societal and environmental impacts of technologies, the application of research to the policy process, and a series of descriptive courses and seminars that examines the relationships between policy, technology, and institutions.

Students who wish to take their internship in an area related to technology planning are encouraged to work with public interest law firms, environmental or consumer groups, or one of the several governmental agencies having substantial involvement in technology.

Inquiry about this degree program should be directed to D. E. Abrahamson, 967 Social Sciences Building, 373-7796.

**Interdepartmental Courses**—The interdepartmental directed studies course, ID 3970 (3 to 15 credits), may be used by any University student to design an individual project in an environmentally related area. Students consult an adviser in the Office for Special Learning Opportunities (OSLO), 201A Wesbrook Hall, and two or more instuctors. Staff members in the OSLO office (373-7550) can provide more information.

## INSTITUTE OF TECHNOLOGY

**Department of Aerospace Engineering and Mechanics**—Students may select a concentration in environmental and biological systems as one of several program options in aerospace engineering and mechanics. More information can be obtained from A. S. Berman, 119B Aeronautical Engineering, 373-2164; or G. S. Beavers, 101 Aeronautical Engineering, 373-5010.

**Department of Agricultural Engineering**—See description under College of Agriculture.

**School of Architecture and Landscape Architecture**—The architecture and landscape architecture programs are of direct environment interest. The four degree programs offered by the School of Architecture and Landscape Archetecture are the bachelor of environmental design, bachelor of landscape architecture, bachelor of architecture, and master of architecture. Further information can be obtained from the Institute of Technology Bulletin or from L. LaVine, 110 Architecture, 376-4525.

**Department of Chemical Engineering and Materials Science**—The department offers an environmentally oriented program in ecochemical engineering. For information about this program, contact H. Tsuchiya, 251 Chemical Engineering, 373-2306; or A. Frederickson, 431 Chemical Engineering, 373-2312.

**Department of Civil and Mineral Engineering**—The Department of Civil and Mineral Engineering offers specializations in several areas of environmental concern: environmental engineering, mineral engineering, surveying and land use plan-

ning, transportaion, and water resources. During their junior and senior years, students take four or more courses in the area of specialization and one or two in several of the other areas. Graduate study and research in environmental engineering focus on the water environment; course offerings and research in aquatic chemistry and pollution abatement technology emphasize measurement dispersion, transformations, and modeling of trace contaminates.

**Environmental Intern Program**—An environmental intern program has been designed to give interested undergraduate students direct experience in working with state and local agencies on ongoing or new programs in environmental protection and conservation. Participating agencies include, but are not limited to, the Minnesota Pollution Control Agency, the Department of Natural Resources, the Department of Agriculture, the Highway Department, the Metropolitan Council, the State Planning Agency, and the Department of Economic Development. This program involves employment of a student, without salary, for a minimum of 1 academic quarter; the student can register for a full quarter's academic credit (15 credits). Each student works closely with a faculty adviser. For more information contact Walter Maier, 296 Experimental Engineering, 373-2517 or 373-2968.

**Department of Mechanical Engineering**—This department offers work in environmental engineering with emphasis on air pollution, energy utilization, and emission studies. The environmental engineering staff offers courses in particle technology, air quality and conditioning, contaminant control, and thermal environmental engineering. Course work is designed to provide a basic preparation for entry into such areas as the heating, ventilation, and air conditioning industry; air pollution measurement and control activities at the local, state, and federal levels; and the manufacturing of pollution control equipment.

**Interdisciplinary Programs**—A number of interdisciplinary programs that emphasize environmental areas are described in a booklet entitled Some Examples of Undergraduate Interdisciplinary Programs Available in the Institute of Technology. Programs described in this booklet include the following areas: acoustics, agricultural wastes and ecosystems, architecture and environmental design, energy systems, environmental engineering, and transportation. Copies of the booklet are available for inspection in 105 Lind Hall.

## UNIVERSITY COLLEGE

The name University College means many things to many people because under this single rubric are several degree-granting units, each of which has its own particular set of goals and procedures. This unusual situation is the result of University College's unique mission within the larger University of Minnesota system: to house undergraduate experimental programs of collegiate scope. By their nature, therefore, University College's specific programs are experimental and not permanent features in the college (with the exception of the Inter-College Program). From year to year new programs may be added, and programs that have completed their experimental phase may transfer to some other auspices. Presently University College has three degree-granting programs: the Inter-College Program, University Without Walls, and University Scholars.

When no other address is given in the following descriptions, more information about the program can be obtained from the University College office, 105 Walter Library, 373-4638.

The **Inter-College Program** is a traditional program that has no fixed curriculum and allows students to draw from the entire University for their courses. Its purpose is to provide flexibility in the educational program of the undergraduate who finds none of the standard curricula of the other schools and colleges suited to his or her particular interests or objectives. Each candidate arranges a program of study that includes suitable amounts of work in two or more colleges of the University. Upon

completing this approved program the student is granted either a B.A. or a B.S. degree. An applicant for admission should be at least a third-quarter sophomore who has completed a minimum of 1 full quarter, or its equivalent, at the University of Minnesota. Additional information is available at 321 Walter Library, 376-1253.

**University Without Walls** is oriented toward the self-directed student who has clear educational objectives but has met barriers in traditional undergraduate programs. UWW serves students who are geographically isolated, physically handicapped, restricted by responsibilities or financial obligations, or face other major problems. Students are encouraged to pursue their educational goals through nonconventional formats and activities.

UWW does not offer classes of its own; students typically develop a project proposal for each learning activity that is designed to answer questions relevant to their area of interest. UWW students may register for regular courses offered by the University.

UWW evaluates student work in narrative form rather than through grades or credits. The B.A. or B.S. degree granted by this program is based, therefore, not upon the traditional 180 credits and standard grade point average, but rather upon a demonstrated competency in the area the student has chosen to pursue.

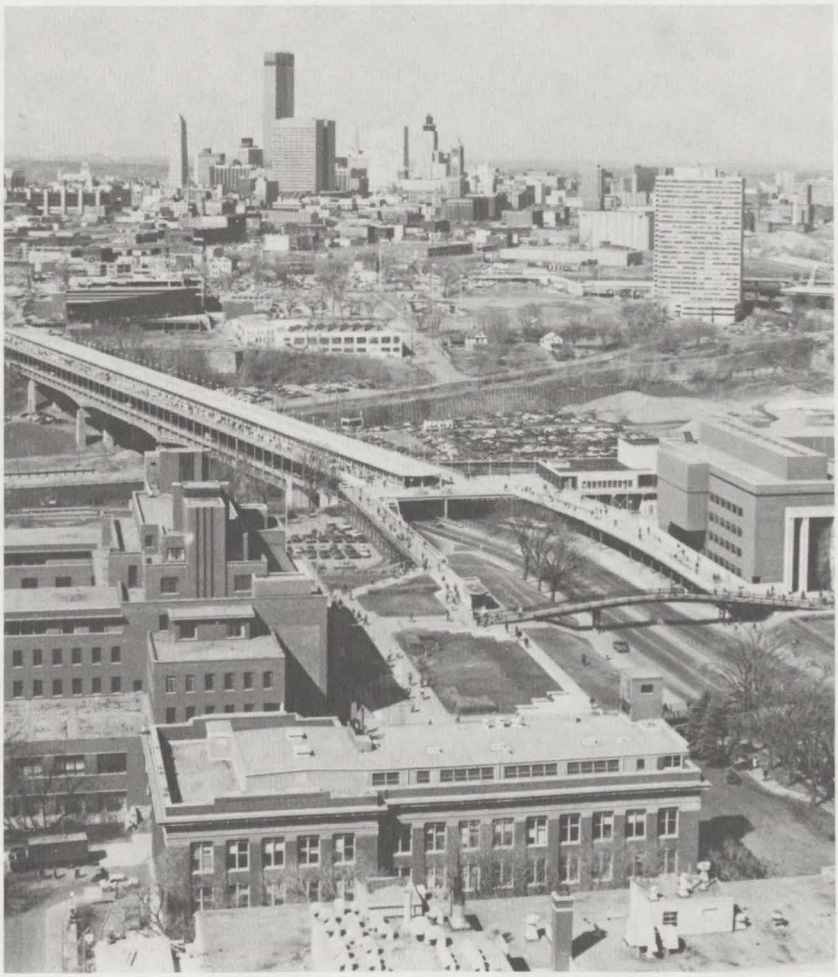
Additional information is available at 201 Wesbrook Hall, 373-3919.

The **University Scholars Program** allows a student and faculty adviser the freedom to construct a baccalaureate degree program based on individually tailored educational goals and learning experiences, which may include travel, internships, and independent reading and research, as well as traditional classroom instruction. The program is directed toward students whose needs are not met by the University's current degree offerings. It is open to any University of Minnesota student who has completed 2 years of college. A student must be nominated for the program by a faculty member who agrees to serve as the students adviser in the program, supervising and assessing the academic work.

The **Foreign Studies Program** is an experimental, individualized interdisciplinary minor pursued in conjunction with students' baccalaureate programs. Its goal is to ensure that, in addition to possessing a substantial background in their chosen field of study, students will have a degree of awareness, understanding, and appreciation of their own culture and of at least one other culture. The program provides for all undergraduate students a formal, international, and interdisciplinary curriculum option that integrates a sequence of selected courses and related foreign study experience. (The courses include foreign language study, 15 credits related to the country or region in which the student has studied, and two 4-credit courses on intercultural communication— Development of Intercultural Skills and Foreign Studies Analysis: Transition to the U.S.A. The student must also earn at least 2 credits as part of the foreign study experience.) Students may participate in the Foreign Studies Program while maintaining enrollment in any other college of the University.

**Other Options**—University College makes available to students regularly enrolled in any undergraduate college of the University of Minnesota an opportunity for independent study when intercollegiate in nature. A student may earn from 3 to 15 degree credits registering for independent study projects under UC 3075. The student designs his or her own project and works with an appropriate faculty member who supervises and evaluates the project.

UC also sponsors a variety of pilot experimental programs and cross-college course work. Further information about any of these programs may be obtained from the University College.



## SUBJECT INDEX

This section contains a subject index of environmental courses. While some courses are obviously found in certain collegiate units— law courses that relate to environmental matters in the Law School, for instance— there are general subject areas of which there is no corresponding department. For example, courses dealing with various aspects of air pollution or meteorology/climatology are found in several departments. This subject index identifies such topical areas and steers interested students to the appropriate courses in various colleges or departments.

All courses listed below are described in at least one other University bulletin. Students interested in exploring the full extent of degree programs and course offerings in a specific area should consult the appropriate college bulletin. Graduate-level (8xxx) courses are described only in the *Graduate School Bulletin.*

AIR

ChEn 5801. Air Pollution Control Engineering
GC 1111. Science in Context: Weather and Climate
PlPa 5110. Air Pollution and Its Effects on Vegetation
See also Environmental Health and Department of Mechanical Engineering course listings

CLIMATOLOGY, see Meteorology/Climatology

COMMUNICATION

See School of Journalism and Mass Communication and Department of Rhetoric

CONSUMER PROTECTION

FScN 1010. Man's Food
PubH 5213. Public Health Aspects of Toxic Products
TexC 5622. Issues and Trends in Textile Consumer Protection

DESIGN

See School of Architecture and Landscape Architecture and Departments of Design and Horticultural Science

ECOLOGY

Anth 5116. Cultural Ecology
CE 8550. Analysis and Modeling of Aquatic Environments
Ent 5400. Experimental Ecology
Ent 8300. Experimental Ecology Laboratory
Ent 8305. Insect Ecology
FR 1203. Introduction to Minnesota's Natural Resources
FR 5150. Forest Ecology Seminar
FW 5451. Ecology of Fishery Populations
FW 5561-5562. Wildlife Ecology, Management I and II
GC 1112. Science in Context: Humanity and the Environment
Geo 1013. Origin and Evolution of Life
ME 3402. Ecology, Technology, and Society
MicB 5611. Microbial Ecology
See also General Biology Program and Department of Ecology and Behavioral Biology course listings

ECONOMICS

Anth 5115. Economic Anthropology
IntR 5802. The Prospective World Economy
See also Departments of Economics and Agricultural and Applied Economics course listings.

EDUCATION

FR 5406. Forestry Workshop for Teachers
See also Education course listings

ENERGY

Anth 5117. Energy, Resource Use, and System Change
CE 8415. Hydro and Thermal Power Development
GC 3181. Modern Physical Sciences: Energy Sources and Conversions
ME 5712. Solar Energy Utilization
NSci 3301. Energy, Power, and Society
PA 5151. Energy and Energy Policy
PA 5152. Topics in Energy Policy

ENVIRONMENTAL HEALTH

AgEn 3800. Rural Sanitation and Water Supply
ME 5607. Industrial Ventilation and Contaminant Control
Phcl 8214. Toxicology
See also Environmental Health course listings

EVENING COURSES

See the Extension Classes Bulletin and Extension Classes course listings

FISHERIES

See Department of Entomology, Fisheries, and Wildlife course listings

FOOD/NUTRITION

PubH 5220. Topics in Food Sanitation
PubH 5222. Food Sanitation
Soc 5675. World Food Supply Problems
See also Department of Food Science and Nutrition course listings

FOREST

Ent 5050. Forest Entomology
See also Department of Forest Resources course listings

FUTURISM

See Education, Social and Philosophic Foundations

GEOLOGY

GC 1171. Physical Science: Geology
GC 1172. Physical Science: Historical Geology
See also Department of Geology and Geophysics course listings

HEALTH AND SCIENCE

Biol 3051. Biology and the Future of Man
GCB 3002. Human Genetics, Social Affairs
GCB 3008. The Biology of Cancer
Hum 3049. Science and Humanities
Hum 3101-3102-3103. The Meaning of Humanity: Society and Technology: Community
See also Environmental Health course listings

HISTORY— SCIENCE/TECHNOLOGY

See History of Science and Technology

INSECTS AND INSECT CONTROL

See Department of Entomology, Fisheries, and Wildlife course listings

LAND USE

GC 3292. Social Science: Special Topics: Geographic Perspectives of Urban Problems
Soil 5440. Soil Resources and Land Use
See also Departments of Agricultural and Applied Economics and Geography course listings

METEOROLOGY/CLIMATOLOGY

FR 5240. Meteorology and Forest Fire Management
GC 1111. Science in Context: Weather and Climate
Soil 1262. Introduction to Meteorology
Soil 5240. Microclimatology
See also Departments of Geography, Ecology and Behavioral Biology, and Physics course listings

NOISE

AEM 5687. Fundamentals of Acoustics
AEM 5688. Intermediate Acoustics
AEM 5689. Special Topics in Acoustics
CDis 5704. Noise and Man

POLLUTION CONTROL

AgEn 5810. Agricultural Waste Management
AgEn 5910. Agricultural Waste Management Engineering i
CE 3500. Introduction to Environmental Engineering
CE 5501. Analysis and Design of Wastewater Systems
CE 5510. Solid Waste Management
ChEn 5801. Air Pollution Control Engineering
ChEn 5904. Special Topics in Pollution Control
Law 5215. Environmental Regulation
See also Environmental Health, Resource and Community Development, and Department of Soil Science course listings

POPULATION

EBB 3097. Population Biology
Phil 3303. Ethics, Population, and Environment
Soc 3551. World Population Problems
Soc 5555. Population Theory
Soc 5675. World Food Supply Problems
See also Department of Genetics and Cell Biology

PUBLIC HEALTH

See Environmental Health

RADIATION

See Environmental Health course listings

RECREATION

FR 5232. Management of Recreational Lands
FR 5259. Recreation Land Amenities and the User
FR 5267. Recreation Land Policy
LA 5010. Principles of Outdoor Recreation Design and Planning
See also Education, Recreation and Park Administration course listings

RESOURCES

CE 5405. Hydrology
CE 8415. Hydro and Thermal Power Development
CE 8420. Water Resource Systems Planning
GC 1113. Science in Context: Natural Resources, Their Utilization and Management
IntR 5803. The Steady State Earth
IntR 5831. Analysis of World Futures Models
MinE 5630. Surface Mining Engineering
Rec 5160. Conservation of Natural Resources
Soil 5540. Soil Resources: Environmental Relationships
Soil 5550. Organic Soils
See Departments of Agricultural and Applied Economics, Forest Resources, and Geology

SOILS

Geo 3101. Surficial Geologic Processes
See also Department of Soil Science course listings

SOLID WASTE

AgEn 5810. Agricultural Waste Management
CE 5510. Solid Waste Management
See also Environmental Health course listings

SURFACE MINING

MinE 5630. Surface Mining Engineering
MinE 5710. Environmental Aspects of Mineral Engineering

TECHNOLOGY, IMPLICATIONS OF

NSci 3101. Introduction to Environmental Technology
NSci 3301. Energy, Power, and Society
PA 5151. Energy and Energy Policy
PA 5152. Topics in Energy Policy
PA 5161-5162. Technology Planning
PA 5181. Policy Topics in Communication and Informational Technologies
UC 5501-5502. Problems of Science and the Humanities
UC 5503. Science and the Problem of Value

TRANSPORTATION

CE 5210. Introduction to Transportation Planning
CE 8210. Seminar: Advanced Transportation Planning
Geog 5383. Transportation Geography
ME 5721. Propulsive Systems for Surface Transportation
SMAE 5710, 5711. Transit Systems: Analysis and Design
Tran 3054. Fundamentals of Transportation
Tran 5194. Government Promotion of Transportation
Tran 5195. Government Economic Regulation of Transportation

WATER

EBB 5601. Limnology
EBB 5602. Case Studies in Limnology
Ent 5131. Aquatic Entomology
FW 5454. Fishery Ecology in Polluted Water
Geo 1601. Oceanography
Geo 5611. Groundwater Geology
Geo 5642. Marine Geology
Soil 3218. Seminar: Soil Water, Irrigation, and Tillage
See also Environmental Health and Departments of Agricultural Engineering and Civil and Mineral Engineering

WILDLIFE

See Departments of Entomology, Fisheries, and Wildlife and Veterinary Pathobiology course listings

# COURSE LISTINGS

This section includes course descriptions and, in most instances, the name of an individual who is prepared to advise students desiring more information about the environmental courses in a variety of departments. New courses are always being developed and old courses revised or dropped; hence this listing may not be totally complete or accurate.

## Aerospace Engineering and Mechanics (AEM)

Institute of Technology
107 Aeronautical Engineering
CONTACT: T. A. Wilson, 120 Aeronautical Engineering, 373-2169

**5687. INTRODUCTION TO ACOUSTICS AND ENVIRONMENTAL NOISE.** (4cr; prereq Phys 1291, Math 3221 or equiv; 3 lect and 1 lab hr per wk)
Derivation of the wave equation, plane wave solution, transmission and reflection at boundaries, resonators and mufflers, 3-dimensional wave propagation, properties of environmental noise sources, hearing and perception of sound, acoustic properties of rooms, sound and noise measurements and noise control techniques.

**5688. INTERMEDIATE ACOUSTICS.** (4 cr; prereq 5687; 4 lect-rec hrs per week)
Intended for juniors, seniors, and graduate students, primarily those in aerospace, electrical, and mechanical engineering. Topics include: wave propagation in inhomogeneous media with application to atmospheric and underwater acoustics, propagation in ducts, Kirchoff solution to the inhomogeneous wave equation, radiation from moving sources including rotating machinery.

**5689. SPECIAL TOPICS IN ACOUSTICS.** (4 cr; prereq 5688)
Intended for juniors, seniors, and graduate students, primarily those in aerospace, electrical, and mechanical engineering. Selected topics of current interest to students and staff.

## Agricultural and Applied Economics (AgEc)

College of Agriculture
231 Classroom-Office Building
CONTACTS: J. Waelti, 231D Classroom-Office Building, 373-1604
K. William Easter, 317G Classroom-Office Building, 376-3800

**3610w. COMMUNITY RESOURCE DEVELOPMENT.** (4 cr; prereq 1020-1030 or Econ 1001-1002 or #) Easter, Jensen
Basic concepts of resource use including physical and economic classifications; physical and economic feasibility; benefits and costs; external effects; cost sharing; selected resource use problems. Economic areas and units for planning and development; generating alternative program elements and developing consequences; problems in choosing elements for an optimum resource development program.

**5130. LAND RESOURCE USE.** (3 cr; not open to agricultural economics majors; prereq 1020, 1030) Waelti
Land as a factor in production; rural and urban utilization; rents and land values; land classification; taxation; exchange; public land management.

**5600. LAND ECONOMICS.** (4 cr for undergrad, 3 cr for grad; prereq 3101, 3102 or Econ 3101, 3102 or #) Raup
Land as a factor in production; land use, classification, and value; sale and rental markets for land; domestic and foreign land policies.

**5610. INSTITUTIONAL FACTORS: LAND USE.** (4 cr for undergrad, 3 cr for grad; prereq 1020, 1030) Snyder
Public laws and administrative rules, public and private contractual arrangements, monetary and tax policies, public spending and legal procedures that affect land use and development.

**5650. ECONOMICS OF NATURAL RESOURCE POLICY.** (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #) Easter, Waelti
The application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth and resource use issues and their implications for public policy.

**8264. RESOURCE ECONOMICS.** (3 cr; prereq Econ 5162 or ¶Econ 5162 or #) Martin

**8364. SEMINAR: RESOURCE ECONOMICS AND POLICY.** (3 cr; offered when demand warrants) Martin, Easter

**8366. SEMINAR: APPLIED REGIONAL ECONOMICS.** (3 cr; offered when demand warrants)

# Agricultural Engineering (AgEn)

College of Agriculture and Institute of Technology
213 Agricultural Engineering
CONTACT: C. L. Larson, 207 Agricultural Engineering, 373-1331

**3410. HYDROLOGY, WATER CONTROL.** (4 cr; prereq Math 1111, Phys 1032, Soil 1122; 3 lect and 1 rec hr per wk) Larson
The hydrologic cycle— precipitation, infiltration, evaporation, surface runoff. Water table variations, subsurface runoff. Flow in open channels, flow measurements. Watershed runoff, floods. Sediment sources, erosion and sediment control. Water control on a watershed basis.

**3800. RURAL SANITATION AND WATER SUPPLY.** (4 cr; prereq Phys 1031, Chem 1005; 3 lect hrs per wk) Goodrich
Wells, pumps, water supply and treatment. Water supply and waste disposal systems for homes, farmsteads, resorts, and recreational use.

**5400. DRAINAGE AND IRRIGATION.** (4 cr; prereq Soil 3210; 3 lect and 2 lab hrs per wk)
Soil moisture excesses and deficiencies. Theory and design of tile drainage, surface drainage, and sprinkler irrigation systems. Development of irrigation water supplies. Selection of pumps and power units for drainage and irrigation. Economic feasibility. Legal problems and procedures.

**5540. EROSION CONTROL, WATERSHED ENGINEERING.** (4 cr; prereq 3050 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk) Larson
Measurement and mechanics of watershed runoff and soil erosion. Estimating peak runoff, soil losses, and sediment yields. Environmental effects. Principles of small watershed planning for flood control, water storage, and sediment control. Hydraulic design of graded and storage type terraces, grass waterways, diversions, and erosion control structures.

**5550. DRAINAGE AND IRRIGATION ENGINEERING.** (4 cr; prereq 3050 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk) Allred
Flow of water through agricultural soils. Irrigation and drainage requirements, salinity control. Evapotranspiration, water supply development and control. Conveyance of drainage systems. Design, layout, and construction of irrigation and drainage systems. Instructional, environmental, and economic aspects of soil moisture control.

**5810. AGRICULTURAL WASTE MANAGEMENT.** (4 cr; prereq Phys 1031, Chem 1005, Biol 1001; 3 lect and 3 lab hrs per wk) Moore
Characteristics of various animal manures, plant materials, and processing wastes. Sanitary collection, storage, treatment, and utilization or disposal of liquid and solid agricultural waste.

**5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING I.** (4 cr; prereq 3050, Chem 1005 or 1014 or #; 3 lect and 3 lab hrs per wk) Moore
Sources and characteristics of agricultural wastes including animal manures, crop residues, sediments, processing wastes, and domestic wastes. Effects on the environment. Sanitary collection, storage, treatment, and disposal. Utilization of liquid and solid wastes. Nonurban water supply and quality.

**8500. HYDROLOGIC MODELING: SMALL WATERSHEDS.** (4 cr; prereq CE 5405) Larson
Study and representation of hydrologic processes by mathematical models; infiltration, overland flow, return flow, evapotranspiration, channel flow, and storage. Time-flow relationships. Linear and nonlinear methods. Frequency relationships. Emphasis on parametric methods.

# Anthropology (Anth)

College of Liberal Arts
215 Ford Hall
CONTACT: Elden Johnson, 219 Ford Hall, 373-2601

**5115. ECONOMIC ANTHROPOLOGY.** (5 cr; prereq 1102, 3201 or #)
Analysis and comparison of systems of production and distribution, especially in nonindustrial societies. Relationship among economic and social, political, religious, psychological, and environmental factors.

**5116. CULTURAL ECOLOGY.** (5 cr; prereq 1101, 1102, one ethnographic area course or #)
Survey of the literature on cultural ecology; emphasis on biological approach to ecosystems and population studies.

**5117. ENERGY, RESOURCE USE, AND SYSTEM CHANGE.** (5 cr; prereq 3201 or #)
Social-cultural system factors in the development, production, control, distribution, and use of energy, water, key resources, and food in the United States and other societies. Social-cultural evolution, interaction among different societies, growth and no-growth issues; emerging global interdependence.

**5176. ENVIRONMENTAL ARCHAEOLOGY.** (5 cr; prereq 1101, 3301 or #)
Field and laboratory techniques used to reconstruct past environmental conditions. Paleoecological interpretations.

# Architecture and Landscape Architecture

Institute of Technology
110 Architecture

## ARCHITECTURE (Arch)

CONTACT: Lance LaVine, 110 Architecture, 376-4525

**1001. ENVIRONMENTAL DESIGN: MAN AND ENVIRONMENT.** (4cr, §LA 1001) LaVine
Exploration of interaction of man and man's environment using the disciplines of natural and social sciences and the arts as resource background for readings, lectures, discussions, and workshop sessions.

**1002. ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES.** (4 cr, §LA 1002; prereq 1001) LaVine
Nature and effects of various tools and processes of environmental change, ranging from buildings and landscapes to economic policies, climate, and myths. Readings, lectures, discussions, and workshop sessions.

**1003. ENVIRONMENTAL DESIGN: IMPLEMENTATION AND EVALUATION.** (4 cr, §LA 1003; prereq 1002) LaVine
Design projects, discussions, and readings exploring personal abilities to implement and evaluate environmental change.

**1021. HISTORY OF ENVIRONMENTAL DEVELOPMENT: ARCHITECTURE.** (4 cr, §LA 1021; 4 lect hrs per wk)
Introduction to architecture, philosophy and principles of architecture as an art; survey of architectural history, with emphasis upon development of contemporary architecture from its roots in the 19th century until the present time.

**1022. HISTORY OF ENVIRONMENTAL DEVELOPMENT: LANDSCAPE ARCHITECTURE.** (4 cr, §LA 1022; prereq 1021; 4 lect hrs per wk)
Forces and individuals that shaped the form of landscape architecture in 19th- and 20th-century America.

**1023. HISTORY OF ENVIRONMENTAL DEVELOPMENT: PLANNING.** (4 cr, §LA 1023; prereq 1022; 4 lect hrs per wk) Odegard
Survey of rise and history of cities as centers of civilization. Collaboration among various disciplines for creating better urban environment and improving the quality of human life in cities.

**5170. CITYSCAPE.** (3 cr; prereq 5093 or #)
The city and its components as aesthetic elements. An examination of factors that have helped to generate urban form.

**5171, 5172. URBAN FORM.** (3 cr per qtr; prereq 5138 or 5139)
Principles and techniques involved in city design.

**5950. TOPICS IN ARCHITECTURE.** (4 cr; prereq 3093 and 3076 or #)
Special topics of concern to the field of architecture. Sec. 1: Toward Humanitarian Architecture; Sec. 2: Housing and Values.

## LANDSCAPE ARCHITECTURE (LA)

CONTACT: P. Olin, 422 Alderman Hall, 373-1663

**1024. LANDSCAPE THEORY.** (4 cr; 3 lect and 3 lab hrs per wk)
Analysis of design elements and forms involving direction, shape, proportion, and color, with emphasis on their function in design; perception and our relationship to our environment; and the social effects and psychological basis for design.

**1031. INTRODUCTION TO LANDSCAPE ARCHITECTURE.** (4 cr; 4 lect hrs per wk)
Design potential of materials of the landscape; exercises in assessment of land developments and detail landscapes; the role of the landscape architect in shaping the natural and cultural environment; brief historical review of site developments.

**3073. LANDSCAPE TECHNOLOGY: LAND ANALYSIS TECHNIQUES.** (4 cr; prereq 3072; 2 lect and 6 lab hrs per wk)
Lectures, exercises, and projects in land analysis techniques for use in assessment of land development potential.

**5010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.** (4 cr; 4 lect hrs per wk)
(Same as FR 5233) For advanced students associated with design, management, and planning of recreational facilities. Planning and design principles related to recreational land use and development; parks, campsites, water areas, highways, summer and winter recreational facilities.

# Biology (Biol)

College of Biological Sciences
223 Snyder Hall
CONTACT: Norman Kerr, P180 Kolthoff Hall, 373-3640

**1011. GENERAL BIOLOGY.** (5 cr)
Introduction to the principles of biology. The cell, metabolism, heredity, reproduction, ecology, and evolution.

**1102. MICROBES AND MAN.** (4 cr)
Microorganisms in relationship to humans and their environment in the processing and preservation of food, waste disposal, and environmental factors; bacterial products of industrial and pharmaceutical importance; role of microorganisms in recycling elements of the biosphere; microorganisms and disease.

**1103. GENERAL BOTANY.** (5 cr, §3012; prereq 1011) Wetmore, Charvat
Levels of organization of plants, plant function, plant growth and development, plant reproduction.

**1105. ECOLOGY AND EVOLUTION.** (4 cr; prereq 1011 or 1101) Birney, Pace
Evolutionary processes, interactions of organisms with their environments, predictions about living systems, including that of humans.

**1106. GENERAL ZOOLOGY.** (5 cr; prereq 1011) Schmid, Underhill
Survey of animal phyla; structure, function, behavior, adaptation, and evolutionary relationships.

**3021. BIOCHEMISTRY.** (4 cr, §BioC 5001; prereq 1011, 12 cr organic chemistry)
Biochemistry and biophysics of cells; emphasis on enzyme catalysis, cellular energetics, biosynthesis of cellular constituents and cellular regulatory mechanisms.

**3041. ECOLOGY.** (4 cr, §5041; prereq biology major, Math 1231 or #, △)
Interactions of plant and animal populations and their environments. Organization, functioning, and development of ecological systems; population growth and regulation. Human impact on the biosphere.

**3042. LABORATORY IN ECOLOGY.** (2 cr; prereq 3041 or 5041 or EBB 3004 or #)
Student research projects on selected ecological problems.

**3051. BIOLOGY AND THE FUTURE OF MAN.** (4 cr; S-N only) Pratt, Gorham
Nontechnical discussion of biological factors affecting the quality of life; e.g., pollution, chemical and biological warfare, population growth, food supply, resource sufficiency, value of wilderness, genetics and eugenics, public health, aging, behavior control, and biological aspects of ethics, morals and societal organization.

**5951. THE BIOLOGIST AS SCIENTIST, EDUCATOR, AND CITIZEN.** (3 cr; prereq 15 cr in biological sciences) Hooper, Cunningham
The role of the scientist in decision making and persuasion; teaching methods in biology; the organizational structure of the academic and governmental worlds.

# Botany (Bot)

College of Biological Sciences
220 Biological Sciences Center
CONTACT: D.C. Pratt, 220 Biological Sciences, 373-2211

**1009. MINNESOTA PLANT LIFE.** (4 cr; suitable for nonmajors) Morley
Identification of the more common and conspicuous Minnesota plants with some discussion of their basic distinctions, life cycles, habitat requirements, distribution, and ecological relations. Lectures, demonstrations, six or seven field trips.

**1012. PLANTS USEFUL TO MAN.** (4 cr; for majors or nonmajors) Jonas
Roles that plants have played in human biological and cultural development. Lectures and demonstration of material.

**3071. PLANTS AND HUMAN AFFAIRS.** (4 cr; prereq #) Jonas
Reciprocal and deterministic interaction between plants and humans as illustrated by events and developments in agriculture, industry, trade, domestic and foreign affairs, medicine, religious customs, and the arts.

**3201. INTRODUCTORY TAXONOMY.** (3 cr; prereq Biol 1003 or 3012)
Taxonomy of ferns, gymnosperms, and flowering plants (representative material drawn largely from Minnesota spring flora). Families of plants and their relationships; floral structure and function; taxonomic terms, nomenclature; literature; methods of collection and identification. Two or three field trips.

**5205. FLORA OF MINNESOTA.** (4 cr; prereq 3201 or #) Ownbey
Vascular plants of Minnesota; taxonomic and floristic relationships; geographical distribution and variation; collection and identification. Field trips.

**5231. INTRODUCTION TO THE STUDY OF ALGAE.** (5 cr; prereq 10 cr in botany or biology or #; offered 1978-79 and alt yrs)
Structure, reproduction, and life histories of major algal divisions.

Courses are offered at the Lake Itasca Forestry and Biological Station in the summer. A separate bulletin is published annually; it is available after January from the Summer Session, 135 Johnston Hall, 101 Pleasant Street S.E., University of Minnesota, Minneapolis, Minnesota 55455.

## Business, Government, and Society (BGS)

College of Business Administration
225 Business Administration
CONTACT: R. J. Holloway, 1235 Business Administration, 373-4407

**3002. BUSINESS AND SOCIETY.** (4 cr; prereq jr or sr) Holloway
Basic economic and social goals and attempts to meet them in American society. Business as an institution; its relationships to other institutions and to society. Ethical and practical conflicts in the firm and the manager in public policy. Current social issues and their impact on business.

**3003. BUSINESS AND THE NATURAL ENVIRONMENT.** (4 cr; prereq jr or sr) Holloway
Business and its relationship to the natural environment. The use by industry of renewable and nonrenewable resources. Environmental deterioration caused by business to air, land, and water. Business solutions to environmental problems.

## Chemical Engineering (ChEn)

Institute of Technology
151 Chemical Engineering
CONTACTS: W. Ranz, 151N Chemical Engineering, 373-2296
A. Fredrickson, 431 Chemical Engineering, 373-2312

**5751f-5752w-5753s. BIOLOGICAL ENGINEERING ANALYSIS.** (3 cr per qtr; prereq #; 3 lect hrs per wk) Keller, Fredrickson
Modeling and analysis of biosystems. Thermodynamics, transport and transfer, biochemical reactions, growth and death processes discussed from both deterministic and probabilistic viewpoints.

**5754. BIOCHEMICAL ENGINEERING.** (4 cr per qtr; prereq 5103 or #; 3 lect hrs per wk) Tsuchiya, Valentas
Biochemical engineering of industrially important biological materials. Microbiological, biochemical, and chemical considerations of these systems and their industrial processing.

**5755. BIOCHEMICAL ENGINEERING.** (4 cr; prereq 5103, 5754 or #)
Application of chemical engineering principles to the solution of processing problems of industrially important biological materials. Statistical experimental design of industrial systems.

**5801. AIR POLLUTION CONTROL ENGINEERING.** (4 cr; 4 lect hrs per wk)
Analysis and design of equipment used to reduce emission of gases and particulates. Methods for controlling air pollution.

**5904. SPECIAL TOPICS IN POLLUTION CONTROL.** (Cr ar)
Special topics to be taught winter and/or spring quarters. For further information, contact W. Ranz, 151 Chemical Engineering, 373-2296.

## Civil Engineering (CE)

Institute of Technology
112 Mines and Metallurgy
CONTACT: W. Maier, 296 Experimental Engineering, 373-2517

The department welcomes participation in its courses by non-IT students with adequate preparation. CE 5420, Introduction to Water Resources Management, is especially designed to combine nonengineering and engineering students in its program and may be used by students in the College of Liberal Arts for credit toward the B.A. degree.

**3500. INTRODUCTION TO ENVIRONMENTAL ENGINEERING PROBLEMS AND ANALYSIS.** (4 cr; prereq Chem 1005)
Environmental problems and an interdisciplinary approach to problem solving. Water pollution, water pollution control technology, air pollution, air pollution control technology, noise, alternative energy resources, solid waste disposal, nuclear energy, radioactive wastes and the overall impact of technology on environmental quality.

**5104. PHOTOGRAMMETRY.** (4 cr; prereq Math 1211; 3 lect and 3 lab hrs per wk)
Stereoscopy and parallax; geometry of single and overlapping photographs; stereoscopic plotting instruments; flight planning; aerial cameras and calibration; mosaics; terrestrial photogrammetry; principles of photo interpretation; elements of remote sensing; and applications to resource evaluation.

**5210. INTRODUCTION TO TRANSPORTATION PLANNING.** (4 cr; prereq #)
The transportation planning process for urban areas; data requirements and travel characteristics; trip generation analysis; models of travel distribution; transit characteristics and usage; selection and evaluation of alternate transportation proposals; transportation and land use linkages.

**5401. WATER RESOURCES ENGINEERING.** (4 cr; prereq 3400 or #)
Introduction to hydraulic engineering, including conduit flow, pumps, open channel flow measurements.

**5402. HYDRAULIC ANALYSIS.** (4 cr; prereq 5401 or #)
Computer applications in hydraulic engineering with emphasis on iteration techniques and finite increment methods applied to open channel flow profile analysis; analysis of flow through spillways, bridge waterways, culverts and similar structures.

**5405. HYDROLOGY AND HYDROLOGIC DESIGN.** (4 cr; prereq 5401 or #; 3 lect and 3 lab hrs per wk)
Hydrologic cycle, precipitation, evaporation, infiltration, runoff analysis, flood routing, statistical procedures in hydrology, urban hydrology, introduction to mathematical models of medium and large watersheds, application of hydrology to design of outlet works and flow control structures.

**5410. OPEN CHANNEL HYDRAULICS.** (4 cr; prereq 5401 or #; 3 lect and 2 lab hrs per wk)
Mechanics of flow in open channels including gradually varied, spatially varied, and rapidly varied flow; unsteady flow (waves and surgers); and flow in alluvial channels.

**5420. INTRODUCTION TO WATER RESOURCES MANAGEMENT.** (4 cr)
The present state of our water resources; water resources planning; implementation.

**5500. ANALYSIS AND DESIGN OF WATER SUPPLY SYSTEMS.** (4 cr; prereq 3500 or #; 3 lect and 3 lab hrs per wk)
Planning and engineering design considerations in developing water supply systems for urban centers. Supply, quality, storage, treatment, distribution, and cost analysis.

**5501. ANALYSIS AND DESIGN OF WASTEWATER SYSTEMS.** (4 cr; prereq 3500 or #; 3 lect and 3 lab hrs per wk)
Planning and engineering design considerations in developing waste disposal systems for urban centers. Volume and quality of waste streams, treatment, and ultimate disposal of domestic and industrial wastewaters and storm water runoff. Environmental effects, cost, and political aspects of ultimate disposal.

**5505. WATER QUALITY AND TREATMENT.** (4 cr; prereq 3400, 3500)
Chemical and physical properties of natural waters, composition of natural waters, introduction to aquatic biology, and ecological considerations of element cycling of natural carbon, nitrogen, phosphorus, oxygen, and anthropogenic chemical species (pesticides, PCBs, heavy metals). Physical and chemical processes of water treatment.

**5510. SOLID WASTE MANAGEMENT.** (4 cr; prereq 3500 or #; 3 lect and 3 lab hrs per wk)
Solid waste disposal for urban areas in terms of volume, composition, and chemical characteristics. Methods and equipment for collection and treatment. Various disposal methods in terms of their effects on the environment and unit costs.

**8210. SEMINAR: ADVANCED TRANSPORTATION PLANNING.** (3 cr; prereq 5210 or #)

**8413. MECHANICS OF SEDIMENT TRANSPORT.** (3 cr; prereq 5410 or #)

**8415. HYDRO AND THERMAL POWER DEVELOPMENT.** (3 cr; prereq 5405; 2 lect and 3 lab hrs per wk)

**8419. WATER RESOURCES SYSTEMS SIMULATION.** (4 cr; prereq 5420)
Computer simulation of water resources systems, stream flow, and quality; economics and sociopolitical systems.

**8420. WATER RESOURCES SYSTEMS PLANNING.** (4 cr; prereq 5420 and experience in computer use; 3 lect and 2 lab hrs per wk)

**8425. GROUNDWATER HYDRAULICS.** (3 cr; prereq 3400)
Flow of fluids through porous media including fundamental equations of flow; application of theories to seepage under dams, wells, and stratified media.

**8430. LAKE, RESERVOIR, AND OCEAN HYDRODYNAMICS.** (3 cr; prereq 3400)

**8502. TECHNIQUES OF WATER AND WASTEWATER ANALYSIS.** (4 cr; prereq 8505 or #)
Method of sampling and analysis of major and minor elements. Laboratory emphasis on modern analytical procedure.

**8505. AQUATIC CHEMISTRY FOR ENVIRONMENTAL ENGINEERS.** (4 cr; prereq #; 3 lect and 1 lab hr per wk)
Principles of physical-inorganic chemistry applied to natural waters and treatment processes.

**8506. TRACE METAL CYCLING IN THE AQUATIC ENVIRONMENT.** (4 cr; prereq 8505 or #; 4 lect hrs per wk)
Confirmation of principles introduced in CE 8505 with emphasis on metals.

**8550. ANALYSIS AND MODELING OF AQUATIC ENVIRONMENTS.** (4 cr; prereq #; 3 lect and 2 lab hrs per wk)

**8551. SEMINAR: MODELS OF AQUATIC ENVIRONMENTS.** (1-5 cr; prereq 8550)

## Communication Disorders (CDis)

College of Liberal Arts
110 Shevlin Hall
CONTACT: W. D. Ward, 2630 University Avenue S.E., 373-4565

**5704s. NOISE AND MAN.** (4 cr; prereq 5301 or #) Ward
Temporary and permanent effects of steady, intermittent, and impulse noises on hearing. Annoyance and community noise. Noise measurement, reduction, and control; ear defenders and their limitations. Hearing conservation programs; preemployment testing and monitoring audiometry.

## Criminal Justice Studies (CJS)

College of Liberal Arts
314 Social Sciences
CONTACT: Jim DeConcini, 314 Social Sciences, 373-2613 or 373-9918

**5106. LAW AND SOCIAL ISSUES.** (4 cr; prereq Soc 3102 or 3103 or #) Samaha
How far the law can go in solving pressing social issues that impinge upon individual liberties such as sexual relations, drug use, abortion, family relationships.

## Design (Dsgn)

College of Home Economics
200 McNeal Hall
CONTACT: Gertrude Esteros, 240E McNeal Hall, 373-1015

**1501. INTRODUCTION TO DESIGN.** (3 cr)
Awareness of design in the near environment.

**1552. INTRODUCTION TO HOUSING AND INTERIOR DESIGN.** (3 cr, §1551; prereq soph)
Problems involved in choosing location and planning or selecting a dwelling unit and its furnishings. Emphasis on design and appraisal of individual and family needs.

**3563. ART AND THE ENVIRONMENT.** (3 cr; prereq soph)
Art and design in housing; an individual's role and responsibility; contemporary and historic examples of alternative approaches to design of the physical home environment.

**5565. HOMES OF THE WORLD.** (3-4 cr; prereq 1551 or 1553 or 3563 or equiv)
Home design in selected regions of the world.

**5581. DESIGNED ENVIRONMENT AND AGING.** (4 cr, §PA 5681)
Design of environments with potential to compensate for deficits in physical and mental functioning; emphasis on older adults and on barrier-free, flexible, and responsive physical environments.

## Ecology and Behavioral Biology (EBB)

College of Biological Sciences
310 Biological Sciences Center
CONTACT: Margaret B. Davis, 108 Zoology, 373-5177

**3001. INTRODUCTION TO ECOLOGY.** (4 cr; open to jrs and above, but not to biology majors) Corbin
Basic concepts in ecology; the organization, development, and functioning of ecosystems; population growth and regulation. Human impact on such systems.

**3004. FUNDAMENTALS OF ECOLOGY.** (4 cr; not open to biology majors; prereq Biol 1011, college algebra) Tester
Relationships between organisms and their environment; ecosystem structure and function emphasizing energy flow, biogeochemical cycling and succession; population dynamics; regional biotic communities.

**3097 (formerly Zool 3097). POPULATION BIOLOGY.** (4 cr; prereq Biol 3032 or 3033 or GCB 3022) Merrell
Principles of population biology. Adaptation of natural populations to their environment and genetic mechanisms by which they respond to environmental change.

**3101. ECOLOGY FOR ENGINEERS AND PHYSICAL SCIENTISTS.** (4 cr, §3001; not open to biology majors; prereq Math 1231) Megard, Bright
Description and analysis of the spatial and temporal interactions between populations in ecosystems with emphasis on the processes affecting populations, transformations of energy and materials in the biosphere. Lectures and recitations.

**5014. ECOLOGY OF PLANT COMMUNITIES.** (5 cr; prereq 3004 or Biol 3041, 1 qtr statistics or #) Cushing
Methods of describing, sampling,, and classifying plant communities; theory of their structure, development, and stability of the interactions among their constituent populations. Field trips to examine local vegetation types; analysis of quantitative data.

**5016. ECOLOGICAL PLANT GEOGRAPHY.** (5 cr; prereq 3004 or Biol 3041, Bot 3201 or ¶Bot 3201 or #) Cushing
Vegetation regions of the world in general and North America in detail; ecological principles of plant distribution; interpretation of regional and temporal patterns in distribution of vegetation and taxonomic groups. Field trips to floristic regions of Minnesota.

**5031. EVOLUTIONARY ECOLOGY.** (3 cr; prereq Biol 3041 or equiv, #; offered 1979 and alt yrs) Corbin
Evolutionary concepts and theory applied to the study of populations, communities, and ecosystems. Current research and literature emphasized.

**5052. THEORETICAL POPULATION ECOLOGY.** (4 cr; prereq Biol 3041 or 5041 or #) Tilman
Theories of population ecology, including models of growth and regulation of single populations, and of interactions between populations, including competition, predation, mutualism; emphasizes assumptions and rationales of models and their predictions for dynamics, stability and diversity of communities.

**5054 (formerly EBB 5017). PREDATORS.** (3 cr; prereq 5052 or #) Taylor
Energetics, ecology, and evolution of vertebrate and invertebrate predators and insect parasitoids.

**5055 (formerly EBB 5021). PREDATION LABORATORY.** (2 cr; prereq 5054 or ¶5054 and #) Taylor
Individual projects in the behavior and population ecology of predators.

**5114 (formerly Zool 5124). VERTEBRATE BIOLOGY.** (4 cr; prereq Biol 1006 or 3011) Underhill
Vertebrates; their biology, taxonomy, and distribution.

**5118. SYMBIOSIS.** (3 cr; prereq Biol 1106 or 3011) Gilbertson
Interactions of organisms of different species living in intimate physiological association.

**5122. PLANT/ANIMAL INTERACTIONS.** (4 cr; prereq Biol 3011, 3012, or #) Morrow
Herbivority, pollination, seed dispersal. Implications of interaction for plants and animals at organismal, population, and community levels. Coevolution.

**5154. BEHAVIORAL AND PHYSIOLOGICAL ECOLOGY.** (3 cr; prereq adv course work in physiology, behavior, or ecology) Regal
Ecological approach to behavioral and physiological control systems including mechanisms by which animals regulate their positions in time and space and regulate the internal milieu. Orientation, learning and adaptation of behavior, heat and water regulation, bioenergetics, biological rhythms.

**5155. LABORATORY IN BEHAVIORAL AND PHYSIOLOGICAL ECOLOGY.** (3 cr; prereq 5154, or #) Regal
Emphasis on individual directed projects.

**5156 (formerly Zool 5104). COMPARATIVE ANIMAL PHYSIOLOGY.** (5 cr; prereq Biol 1106 or 3011, Chem 3302 or #) Schmid
The environment imposes passive stresses upon organisms— not equilibrium. Various physiological adaptations allow maintenance of homeostasis. Introduction to the passive organism; environmental stresses and biological mechanisms by which they are counteracted.

**5158 (formerly EBB 5561). PHYSIOLOGICAL PLANT ECOLOGY.** (3 cr; prereq Biol 3012 or Bot 3131 or 5131 or #) Morrow
The physical state, distribution and availability to plants of water, nutrients, light, and carbon. Physiological and morphological adaptations of plants for obtaining and retaining these resources. Resource allocation strategies in diverse environments.

**5159. PHYSIOLOGICAL PLANT ECOLOGY LABORATORY.** (2 cr; prereq 5158 or ¶5158 or #) Morrow
Field and laboratory measurements of physiological and morphological responses of plants to their environment.

**5601. LIMNOLOGY.** (4 cr, §Geo 5601; prereq Chem 1005 or #) Shapiro
Description and analysis of events occurring in lakes, reservoirs, and ponds, beginning with their origins and progressing through a study of their physics, chemistry, and biology. Interrelationships of these parameters and effects of civilization on lakes. Laboratory and field trips.

**5602. CASE STUDIES IN LIMNOLOGY.** (3 cr; prereq 5601 or Geo 5601 and #; offered 1978 and alt yrs) Shapiro
Interactions between physical, chemical, and biological phenomena in lakes; relationships between lakes, watersheds, and human activities.

**5603. PLANKTON POPULATIONS.** (5 cr; prereq 5601 or 5812, Biol 3041 or #; lab fee required) Megard
Biology of plankton and analysis of the maintenance and regulation of planktonic populations. Laboratory studies of the taxonomy, morphology, and biology of plankton. Two Saturday field trips.

**5608. ECOSYSTEMS: FORM AND FUNCTION.** (3 cr; prereq 3004 or 5601 or Biol 3041, Chem 1002 or 1005) Gorham
Nature and development of terrestrial, wetland, and aquatic ecosystems. Analysis of energy flow and element cycling in relation to environmental controls, self-regulation, natural and human disturbances.

**5609. ECOSYSTEMS LABORATORY.** (2 cr; prereq 5608 or ¶5608) Gorham
A field and laboratory course to accompany 5608.

**5612. BIOGEOCHEMICAL CYCLES.** (3 cr; prereq Biol 3041 or 5041, Biol 3021 [or BioC 5001] or MicB 5321 or #)
Biogeochemical cycles for essential, nonessential, and toxic elements in the biosphere. Emphasis on human impact on biogeochemical cycles and on the connections between these cycles.

Courses are offered at the Lake Itasca Forestry and Biological Station in the summer. A separate bulletin is published annually; it is available after January from the Summer Session, 135 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, Minnesota 55455.

# Economics (Econ)

College of Liberal Arts
1035 Business Administration
CONTACTS: Edward Coen, 1035 Business Administration, 373-3690
Harlan Smith, 1149 Business Administration, 373-3572

**5021. ECONOMICS, ETHICS, AND ECONOMIC PHILOSOPHY.** (3-5 cr; prereq 1001, 1002 or equiv; offered when feasible)
Literature and issues it raises; relation of ethics to economic organization, practice, and policy. Different economic philosophies; elements involved in formulation of economic philosophy.

**5307. COMPARATIVE ECONOMIC SYSTEMS.** (4 cr; §5337; not open to economics majors; prereq 1001, 1002)
Functions of economic systems; market economy, liberal socialism, centrally planned economy. American and Soviet economies.

**5421. THE PROSPECTIVE WORLD ECONOMY.** (4 cr, §IntR 5802; prereq 5401 or 5431 or #) Smith
Alternative patterns for a future world economy and their implications for the economic welfare of nations. World institutions and their relation to growth and survival problems in a world economy.

**5611. ECONOMICS OF ENVIRONMENTAL CONTROL.** (4 cr; prereq 1001, 1002 or equiv)
Pollution as an external diseconomy; use of taxes and subsidies to reduce pollution. Replenishable resources; maximum sustainable yield; role of the discount rate; taxation to protect yields and minimize harvesting costs. Nonreplenishable resources; controlling rates of depletion.

**5621. ECONOMICS OF URBAN PROBLEMS.** (4 cr; prereq 1001, 1002 or equiv)
Unemployment and central city decay. Minimum guaranteed income proposals. Low income housing policies. Public policies toward health care. Financing public education. Fiscal problems of cities. Mass transit issues.

**5661. ECONOMICS OF LOCATION.** (5 cr for undergrads, 3 cr for grads; prereq 3103, 1 qtr calculus and # for undergrads...5161 for grads)
Location of economic activity in relation to resources and markets. Effects of changes in transport costs. Problems of urban growth.

**5831. COST-BENEFIT ANALYSIS.** (4 cr; prereq 3101 or equiv)
Principles for evaluation of benefits and costs of public projects or programs. Issues connected with definition and measurement of benefits and costs. Rate of return and rate of discount. Treatment of market imperfections, risk and uncertainty.

# Education, Elementary (Elem)

College of Education
CONTACT: Roger T. Johnson, 370 Peik Hall, 373-5793

**5348su. WORKSHOP: OUTDOOR SCIENCE EDUCATION.** (3 cr; prereq elem tchg exper; Itasca State Park) Johnson
Classroom and field work activities dealing with models, materials, and methods in the outdoor setting. The course is held in Itasca State Park. Participants are required to provide sleeping bags and other necessary items. Students are responsible for the costs of food, transportation, and campsite rental. The course covers many aspects of outdoor science including forestry activities, nature trail development, marsh studies, and stargazing.

**5437su. WORKSHOP: CURRICULUM IMPLEMENTATION IN ELEMENTARY SCHOOL SCIENCE.** (3-6 cr; prereq elem tchg exper; Minnesota Zoological Garden) Humphreys
This 3-credit offering focuses on planning, development, and evaluation of zoo-related curriculum materials for elementary schools. Specific adaptations and behaviors considered in the context of general ecological schemes. Participants initiate and revise curriculum packages.

# Education, Recreation and Park Administration (Rec)

College of Education
CONTACT: Leo H. McAvoy, 209 Cooke Hall, 373-4232

**5160. CONSERVATION OF NATURAL RESOURCES.** (3 cr; prereq 1520 or 5100 or △)
Environmental considerations in relation to recreation and leisure services. (Open to nonmajors)

**5300. FOUNDATIONS OF OUTDOOR EDUCATION.** (3 cr; prereq sr, 1520 or 5100 or △)
Investigation of the philosophical, historical, and educational foundations of outdoor education.

# Education, Secondary (SeEd)

College of Education
242 Burton Hall
CONTACT: Eugene Gennaro, 370 Peik Hall, 373-3305

**5394su. WORKSHOP: SCIENCE EDUCATION.** (1-12 cr [max 12 cr])
Analysis of issues, materials, and instructional techniques on current topics of relevance to secondary school and college science teachers.

# Education, Social and Philosophical Foundations of (HEd)

College of Education
203 Burton Hall
CONTACT: Arthur Harkins, 203 Burton Hall, 373-3178

**3210. SOCIETIES OF THE FUTURE.** (4 cr, §SSci 3981) Harkins
Introduction to the area of future studies; application of interdisciplinary analysis to the problems of specialization and generalization of human understanding; alternative images of the futures of formal and informal social systems.

**5175. INTRODUCTION TO SYSTEMS THEORY IN SOCIAL SCIENCE AND EDUCATION.** (3 cr) Harkins
Fundamental aspects of general systems theory; reading; basic modeling techniques.

**5211. SOCIAL DESIGN AND EDUCATIONAL FUTURES.** (3 cr)
Medium-range interdisciplinary approach to community design and analysis emphasizing formal education systems in community context; focus upon new neighborhoods, towns, experimental cities and subcultural enclaves in rural and urban settings emphasizing time period from several years to 3 decades hence.

# Entomology, Fisheries, and Wildlife

College of Agriculture
219 Hodson Hall
CONTACTS: H. C. Chiang, 212 Hodson Hall, 373-1713 (insects)
L. D. Frenzel, 143 Hodson Hall, 373-1715 (wildlife)
T. F. Waters, 120 Hodson Hall, 373-1706 (fisheries)

## ENTOMOLOGY (Ent)

**1005. ECONOMIC ENTOMOLOGY.** (4 cr; prereq Biol 1011 or #)
Brief introduction to structure and classification of insects; management of insect populations; life histories, habits, and recognition of insect pests of livestock, orchards, field crops, vegetables, and ornamentals.

**5020. FIELD ENTOMOLOGY.** (5 cr; prereq introductory biology; offered summer session term I at Itasca)
The insect found in various natural habitats of the park and surrounding areas. Includes field trips, collection and identification of insects, as well as studies of general morphology, life histories, and habitats of local species.

**5050. FOREST ENTOMOLOGY. (4 cr; prereq forestry major or #)**
Lectures and laboratory concerning ecology and population management of forest insects with emphasis on tree factors and biological control.

**5131. AQUATIC ENTOMOLOGY.** (2 cr; prereq 3175 or #)
Identification and biology of aquatic and littoral insects in all stages.

**5210. INTEGRATED PEST MANAGEMENT.** (4 cr; prereq 1005 or #; ¶5211, ¶5212)
Management of insect, mite, and weed populations by the integration of various methods and techniques including biotic agents, host plant resistance, artificial measures, and cultural practices as harmonious systems that, in the context of the associated environment and population dynamics, maintain subeconomic pest densities.

**5250. PRINCIPLES OF ECONOMIC ENTOMOLOGY.** (4 cr; prereq 15 cr zoology and entomology incl 1005 or #; offered 1978-79 and alt yrs)
Methods and principles of insect control. Individual projects.

**5400. EXPERIMENTAL ECOLOGY.** (3 cr; prereq 9 cr biology, 3 cr animal or plant ecology or #)
Experimental approach to study of environmental factors affecting animal populations.

**8300. EXPERIMENTAL ECOLOGY LABORATORY.** (2 cr; prereq 5400 or ¶5400)

**8305. INSECT ECOLOGY.** (3 cr; prereq 5400 or #)
Dispersal, distribution, abundance, natural control, and related problems.

## FISHERIES AND WILDLIFE (FW)

**0001. ORIENTATION IN FISHERIES AND WILDLIFE.** (No cr)
Survey of technical requirements and training of fishery and wildlife technicians and scientists; introduction to fields of work, problems, and career outlets.

**3052. INTRODUCTION TO FISHERIES AND WILDLIFE BIOLOGY AND MANAGEMENT.** (4 cr, §5451, §5561; prereq EBB 3004, non-FW major and pre-FW student)
Introduction to fishery and wildlife population ecology; relationships of fish and wildlife to their environments; management of fish and game populations and habitats; management and research methods; administration of fish and wildlife agencies.

**3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.** (1 cr; offered at Cloquet)
Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.

**5450. TECHNIQUES OF FISHERY BIOLOGY.** (4 cr; prereq 3052, EBB 5813 or Geo 5601, EBB 5136 or #)
Basic methods used in fishery research and management; lake and stream survey methods, mapping, chemical and biological sampling; methods of fish collection, use of nets and traps, electrofishing; tagging and marking; methods of creel census.

**5451. ECOLOGY OF FISHERY POPULATIONS.** (4 cr; prereq 5450 or #)
Relationship of fishery populations to limnological conditions; factors influencing strength of year classes; influence of climatological factors on fish growth; species interactions as related to population structure; influence of natural and fishing mortality rates on structure and yield of exploited populations; fishery yield models.

**5452. FISHERY MANAGEMENT.** (4 cr; prereq 3052, EBB 5813 or #)
Fundamentals of population control; use of fishing regulations; habitat development; water quality control; use of artificial stocks for population maintenance; relationship between sport and commercial fisheries, including economic aspects; fundamentals of hatchery practice; pond management.

**5454. FISHERY ECOLOGY OF POLLUTED WATERS.** (4 cr; prereq 5452, Chem 1006, #)
Toxicity testing, determination of water quality criteria and biological effects of various pollutants on fish and fish production; relationships of fish biology and ecology to water pollution problems and methods for study and solution of problems.

**5561. WILDLIFE ECOLOGY, MANAGEMENT I.** (4 cr; prereq 3052, 5129, EBB 3004, or 5834 or #...courses in soils, plants and animal physiology, experimental or field vertebrate ecology and plant ecology recommended)
Review of ecological background for wildlife management, development of programs in the field, and organizations working with fisheries and wildlife programs.

**5562. WILDLIFE ECOLOGY, MANAGEMENT II.** (4 cr; prereq 5561 or #)
Characteristics of wildlife populations relevant to management including natality, recruitment, and mortality rates, density and behavior.

**5563. WILDLIFE ECOLOGY, MANAGEMENT III.** (3 cr; prereq wildlife sr or #)
Habitat relationships of bird and mammal populations and the ecological basis for habitat management. Lectures, readings, library projects, and local field trips.

# Environmental Health (PubH)

School of Public Health
1158 Mayo Memorial Building
CONTACT: R. D. Singer, 1160 Mayo, 373-8080

**3151s. INTRODUCTION TO ENVIRONMENTAL HEALTH.** (3 cr; prereq 3 cr in public health) Vesley
Principles of environmental health relating to water, food, wastes, housing, accidents, radiation, air, industrial hygiene.

**5150f,w,s,su. TOPICS IN ENVIRONMENTAL HEALTH.** (Cr ar; prereq #)
Selected readings and discussions on problems in environmental health.

**5170f,w,s. TOPICS IN ENVIRONMENTAL BIOLOGY.** (Cr ar; prereq #)
Selected readings in environmental biology with discussion of control techniques.

**5171w. ENVIRONMENTAL MICROBIOLOGY.** (3 cr; prereq 5151, 5155, MicB 3103 or #) Greene
Survival, dissemination, transportation, and significance of microorganisms in the environment; application of principles to environmental health problems.

**5172w. ENVIRONMENTAL MICROBIOLOGY LABORATORY.** (2 cr; prereq 5171, #) Greene, Vesley
Laboratory and field exercises in microbiological sampling,, detection, enumeration, and control.

**5177f. PUBLIC HEALTH BIOLOGY.** (3 cr; prereq #) Ruschmeyer
Introduction to plant and animal forms important in environmental health; biological aspects of water supply, waste treatment, stream pollution, and special phenomena related to human disease transmission.

**5180f,w,s. TOPICS IN AIR POLLUTION.** (Cr ar; prereq #)
Selected readings in air pollution with discussion based on these readings.

**5181f,w. INTRODUCTION TO THE AIR POLLUTION PROBLEM.** (3 cr; prereq #) Paulus
History, sources, controls, effects, surveys, legal aspects; administration of programs.

**5182s. AIR POLLUTION CONTROLS AND SURVEYS.** (3 cr; prereq 5181, #) Paulus, Caplan
Public health engineering approach to air pollution controls and surveys.

**5183f,w,s,su I. PROBLEMS OF AIR POLLUTION CONTROL.** (Cr ar; prereq 5181, #) Paulus
Special supervised studies involving laboratory and field investigation procedures; review of pertinent literature.

**5184w. AIR ANALYSIS I.** (3 cr; prereq 5181, 5183, or 5211, #) Paulus, Caplan
Laboratory and field exercises involving air flow calibration, dynamic calibration of field equipment for analysis of air contaminants, respirable mass sampling, dust counting and sizing, and instrumentation for measuring physical environmental stresses.

**5185s. AIR ANALYSIS II.** (3 cr; prereq 5184, #) Paulus, Caplan
Laboratory and field exercises involving sampling and analysis techniques for stack sampling and for ambient air monitoring. Group surveys of air pollution problems and special projects.

**5194s. OCCUPATIONAL SAFETY.** (2 cr; prereq #) Scheffler
Occupational safety procedures, environmental controls to reduce injuries on and off the job, safety program development and administration.

**5200f,w,s. TOPICS IN RADIOLOGICAL HEALTH.** (Cr ar; prereq #)
Selected readings in radiological health with discussion based on these readings.

**5201f. MEASUREMENT AND APPLICATION OF IONIZING RADIATION.** (3 cr lect and lab, 2 cr lect only; prereq #) Barber
Introduction to principles of measurement and use of radiative sources; emphasis on health hazards.

**5202w. ENVIRONMENTAL RADIOACTIVITY.** (3 cr; prereq 5201 or #) Straub, Barber
Sources, measurement, evaluation, and control of environmental radioactivity; hazards to general population.

**5210f,w,s. TOPICS IN OCCUPATIONAL HEALTH.** (Cr ar; prereq #)
Selected readings in occupational health with discussions based on these readings.

**5211f. INDUSTRIAL HYGIENE ENGINEERING.** (3 cr; prereq #) McJilton
Concepts and techniques used in occupational health; emphasis on fieldwork, evaluation of potential hazards, and preventive techniques.

**5212w. VENTILATION CONTROL OF ENVIRONMENTAL HAZARDS.** (3 cr; prereq 5211, #) Caplan
Theory and application of exhaust ventilation in control of airborne environmental hazards; principles of exhaust hoods, air moving devices, gas cleaning devices; demonstration of measurement techniques; relationship of hazard and process to ventilation design criteria.

**5213s. PUBLIC HEALTH ASPECTS OF TOXIC PRODUCTS.** (2 cr; prereq 5215) Long
Problems of protecting industrial workers and private consumers from useful but potentially harmful products; product testing programs and administration; labeling problems.

**5215w. APPLIED OCCUPATIONAL TOXICOLOGY.** (3 cr; prereq 5181 or 5211, #) Long
Basic toxicology and physiology with emphasis on environmental contaminants. Inhalation toxicology of the work environment and air pollution.

**5220f,w,s. TOPICS IN FOOD SANITATION.** (Cr ar; prereq #)
Review of literature and practice to identify association of food sanitation problems with public health.

**5222s. FOOD SANITATION.** (3 cr; prereq #) Jopke
Review of current literature on sanitary problems in production, processing, and distribution of meat, milk, shellfish, and other foods; methods of supervision.

**5230f,w,s. TOPICS IN INSTITUTIONAL ENVIRONMENTAL HEALTH.** (Cr ar; prereq #)
Review of literature and practice to identify institutional environmental health problems.

**5231f. ENVIRONMENTAL HEALTH AND SAFETY IN HEALTH CARE FACILITIES I.** (4 cr; prereq #) Vesley
Environmental health concepts and problems related to isolation techniques; cleaning, disinfection, and sterilization; laundry processes; food service; physical plants; interdepartmental relationships.

**5232w. ENVIRONMENTAL HEALTH AND SAFETY IN HEALTH CARE FACILITIES II.** (4 cr, §5126; prereq #) DeRoos
Ventilation; water supply; plumbing; solid and liquid waste systems; and other environmental engineering problems.

**5240f,w,s. TOPICS IN WATER HYGIENE.** (Cr ar; prereq #)
Selected readings on and discussions of problems relating to the health aspects of water supply and wastewater systems.

**5241w. ENVIRONMENTAL HEALTH ASPECTS OF WATER SUPPLY.** (3 cr; prereq #) Straub, Singer
Role of water in human health; physical, chemical, and biological characteristics; evaluation of source, treatment and distribution systems.

**5242f. ENVIRONMENTAL HEALTH ASPECTS OF GROUNDWATER SYSTEMS.** (2 cr; prereq #) Singer
Introduction to groundwater geology, quality, and treatment; well design construction, and maintenance; public and environmental health problems.

**5244s. ENVIRONMENTAL HEALTH ASPECTS OF WASTEWATER SYSTEMS. (3 cr; prereq** #) Straub
Role of liquid wastes in human health; physical, chemical and biological characteristics; evaluation of source, treatment and disposal facilities.

**5261f. ENVIRONMENTAL TOXICOLOGY.** (3 cr; prereq #) Long
Application of toxicology to environmental problems; interpretation and evaluation of data, assessment of potential health hazards, and approaches to solution of problems.

**8201s. RADIATION DOSIMETRY.** (3 cr; prereq #) Barber

**8202s. RADIATION DOSIMETRY LABORATORY.**(1 cr; prereq ¶8201) Barber

# Fisheries and Wildlife

See ENTOMOLOGY, FISHERIES, AND WILDLIFE.

# Food Science and Nutrition (FScN)

College of Agriculture and College of Home Economics
225 Food Science and Nutrition
CONTACT: Elwood F. Caldwell, 228 Food Science and Nutrition, 373-1073

**1010. MAN'S FOOD. (4 cr;** §1012; offered by correspondence only) Morris
Human nutritional needs; food composition, world food supply, consumption patterns, acceptance, quality programs and regulations, food preservation, commercial processes, packaging, marketing, national and international food programs.

**5404. CURRENT ISSUES IN FOOD AND NUTRITION.** (2-4 cr; prereq 15 cr in food science and nutrition or #)
Evaluation of popular and scientific literature dealing with nutrition, food additives, food safety, food fads, health foods, environmental contamination, the consumer movement, naturally occurring food toxicants, processed foods, synthetic foods, organically grown foods.

**5643. SEMINAR: WORLD FOOD SUPPLY PROBLEMS.** (4 cr; §AgEc 5790, §PIPa 5220, §Soc 5675, §LACS 5280; prereq sr or grad student with #) Doyle, Busta
A multidisciplinary approach to social, economic, and technical problems of feeding the world's growing population.

# Forest Resources (FR)

College of Forestry
110 Green Hall
CONTACT: K. E. Winsness, 12 Green Hall, 373-0842

**1201. CONSERVATION OF NATURAL RESOURCES.** (3 cr)
Renewable natural resources of the U.S.and the world; their utilization, interrelationship, and management treated from an economic standpoint; their importance to society and our responsibility for their conservation. Lectures and reports.

**1202. FARM AND SMALL WOODLANDS FORESTRY.** (3 cr for non-forestry majors, 2 cr for majors; prereq 1100 for majors)
Status and problems of the small woodland owner. Factors influencing tree growth. Cutting practices for and marketing products of small woodlands. Establishment and care of plantations, shelterbelts, and windbreaks. Field trips.

**1203. INTRODUCTION TO MINNESOTA'S NATURAL RESOURCES.** (3 cr, §1201; for non-forestry students)
Ecological, social, and economic implications of Minnesota's soil, water, forest, wildlife, and other resources are studied in field exercise and group discussions at nature centers and natural areas. Environmental teaching techniques for the elementary indoor classroom.

**3114. FOREST TREE BIOLOGY.** (4 cr; prereq Chem 1004, 10 cr of biology)
The growth, function, and genetics of forest trees. Lecture and laboratory.

**5100. SILVICULTURE.** (3 cr; prereq Itasca Session, 1100, 3101)
Introduction to silvics, silvicultural systems, intermediate cuttings, and related practices. Forest regeneration problems and techniques.

**5102. REGIONAL SILVICULTURE.** (3 cr; prereq 5100 or #)
Forest regions of North America emphasizing silvical, historical, geographic, economic, and other determinants of forest management. Topics and field trips on special problems of current concern.

**5105. INTENSIVE SILVICULTURE.** (3 cr; prereq sr in forestry)
Principles and techniques underlying silvicultural systems aimed at high productivity. Current practices in various forest regions of the United States and the world. Lectures and guest speakers.

**5114. FOREST HYDROLOGY AND SOILS.** (5 cr; prereq Itasca Session, Geo 1001, or #)
Water and its relation to forests and forest management. Effects of managing the forest system on components of the hydrologic cycle with emphasis on soil water content, evapotranspiration and quantity and quality of runoff. Basic soil science including chemical and physical properties, soil genesis, and classification. Role of soils in determining tree species distribution and productivity.

**5150. FOREST ECOLOGY SEMINAR.** (3 cr; prereq sr, 3101, 5100, or #)
Survey of classical concepts and contemporary developments in ecology as related to forestry. Discussion group format.

**5151. MULTIPLE-USE SILVICULTURE.** (3 cr; prereq sr, 5100, or #)
Wildlife production, aesthetics, wilderness area management, minor forest products, noise and air pollution, and other non-timber production forest uses. Classical and recent contributions.

**5222. FOREST POLICY AND ECONOMICS.** (5 cr; prereq AgEc 1030)
Forest resource supply and consumption relationships, U.S. and world; legal and political factors; basic economic and financial analysis of forestry activities (production, consumption, and investments).

**5232. MANAGEMENT OF RECREATIONAL LANDS.** (3 cr; prereq jr in forestry or #)
Recreational use of the forest and associated land and water. Policy problems arising from recreational demands.

**5233. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.** (4 cr; prereq 5232 or #)
(Same as LA 5010) For advanced students associated with design, management, and planning of recreational facilities. Planning and design principles related to recreational land use and development; parks, campsites, water areas, highways, summer and winter recreational facilities.

**5240. METEOROLOGY AND FOREST FIRE MANAGEMENT.** (4 cr; prereq ¶1100, Itasca Session, wildlife management major or #)
Fundamentals of meteorology and climatology and applications to forestry. Forest fire behavior, administration of forest fire control, and applications of prescribed burning.

**5257. RECREATION LAND POLICY.** (3 cr; prereq 5232 or #)
Policy issues affecting the use and management of lands devoted entirely or in part to recreational objectives.

**5259. RECREATION LAND AMENITIES AND THE USER.** ( 3 cr; prereq 5232, RRM major or grad student or #)
Principles of management of parks, forests, and other areas for recreation visitors. The role of interpretive education. User preference in relation to administrative objectives. Individual and group influences. Lectures, discussions, reports, readings.

**5406su. FORESTRY WORKSHOP FOR TEACHERS.** (5 cr; prereq teacher or #; offered at Cloquet Forestry Center)
Study of forest ecosystems and forest management in lecture and laboratory sessions. In field exercises, techniques and materials are developed for the teaching of principles of forestry in indoor and outdoor classrooms. Tours to forest and wildlife research and management units and utilization locations, and discussions of contemporary forestry issues by guest lecturers.

Courses are offered at the Lake Itasca Forestry and Biological Station in the summer. A separate bulletin is published annually; it is available after January from the Summer Session, 135 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, Minnesota 55455.

# General College (GC)

106 Nicholson Hall
CONTACT: A. Johnson, 113 Folwell Hall, 373-3723

Credits for General College courses are accepted by other University colleges on an individual basis. Before registering, please check with your college office.

**1111. SCIENCE IN CONTEXT: WEATHER AND CLIMATE.** (5 cr; 5 lect, 1 lab hr per wk)
Day-to-day and long-range weather patterns studied in terms of interactions among atmosphere, oceans, land surfaces, and earth motions. Fair weather, storms, seasonal change, climatic change, air pollution, and distribution of moisture and energy considered from theoretical as well as applied standpoints. Basic principles of science applied to analyzing and forecasting weather, interpreting climates and climatic change, and realizing the great extent to which individuals interact with the atmospheric environment.

**1112f,w,s. SCIENCE IN CONTEXT: HUMAN USES OF THE ENVIRONMENT.** (5 cr)
Study of ecology as applied to aspects of our past, present, and future existence; application of biological principles and interrelationships between the individual and the environment. Principles of ecology as seen in structure and function of ecosystem; pollution of soil, water, and air resources; population explosion; and relationship of people, disease, food production, environmental controls to survival.

**1113f,w,s. SCIENCE IN CONTEXT: NATURAL RESOURCES, THEIR UTILIZATION AND MANAGEMENT.** (5 cr)
Characteristics and management of land, water, air, soil, minerals, grasslands, forests, and wildlife in both Minnesota and the United States. Designed to provide basis for intelligent decision making by citizens.

**1131f,w,s. BIOLOGICAL SCIENCE: PRINCIPLES.** (5 cr)
Variety and relationships of living organisms illustrating general principles of biology as they apply to humans, animals, and plants. Principles drawn from such fields of study as cells, relationships of organisms in nature, heredity, chemical and physical properties of living organisms in nature, evolution, and reproduction. Student spends about 2 hours a week in multimedia laboratory working on biological information and biological problems with aid of tapes, pictures, graphs, movies, and experiments.

**1133. NATURE STUDY.** (4 cr)
Appreciation of wild plants and animals in their natural environment. Techniques of field instruction for groups of children and adults interested in nature. Identification, behavior, and relationships of living things. Individual projects may be assigned, such as writing nature poetry; drawing, sketching, or painting plants and animals; studying life histories of plants and animals; recording sounds and calls; studying effect of specific chemicals on plants and animals; cultivating house plants; and collecting insects or leaves. Lectures, laboratories, and field trips.

**1171. EARTH SCIENCE: GEOLOGY.** (5 cr; 5 lect, 1 lab hr per wk)
Emphasis on description of common land features— valleys, mountains, hills and lakes— and on processes responsible for their origin and change. Types of surface materials, such as rocks and glacial deposits.

**1172. EARTH SCIENCE: HISTORICAL GEOLOGY.** (5 cr; prereq 1171; 5 lect, 1 lab hr per wk)
Principles of physical geology enlarged upon and used as tools to unravel earth's past as recorded by rocks and fossils. Development of earth's physical features and changing patterns of life through time, with implications of the problems that challenge human existence. Emphasis on problem solving and logical deductions from facts rather than on memorization.

**1921. ENVIRONMENTAL PROBLEMS: NATURAL SCIENCE.** (4 cr; prereq ¶1922, 1923, 1924)

**1922. ENVIRONMENTAL PROBLEMS: SOCIAL SCIENCE.** (4 cr; prereq ¶1921, 1923, 1924)

**1923. ENVIRONMENTAL PROBLEMS: WRITING.** (4 cr; prereq ¶1921, 1922, 1924)

**1924. ENVIRONMENTAL PROBLEMS: HUMANITIES.** (4 cr; prereq ¶1921, 1922, 1923)
Environmental problems such as pollution, overpopulation, starvation, crises in urban ecology, and exploitation of natural resources are studied and possible solutions formulated. Social, scientific, and humanistic aspects of various problems are interrelated by staff members with diverse backgrounds and interests. Emphasis on individual and small-group investigation and reporting.

**3114. PERSONAL ENVIRONMENTAL HEALTH.** (5 cr; prereq 1132)
Health as a product of harmony between the individual and environment: biological, physical, social, and ideological. Content selected from following topics: personal health— interaction of mind and body, progress in medicine; environmental health— impact of new types of pollution, environment and personality, occupational health and industrial medicine, community health organizations and consumer costs, health in college community.

**3134. NATURE AND ITS IMPACT ON THE MIND.** (4 cr)
Begins with field trips to some exciting natural areas in University vicinity. Aspects of nature that may be common to arts of various societies— ranging from leaf patterns to bird songs to smells of different types of forests and prairies— studied and appreciated in their natural settings. Students try to interpret what they have sensed in visual and literary arts. Some attempt simple scientific experiments. Includes reading and discussing treatment of nature in selected literature and analysis of nature art in local galleries and slide collections.

**3181. MODERN PHYSICAL SCIENCES: ENERGY SOURCES AND CONVERSIONS.**(4 cr; prereq one college course in physics and in chemistry)
Principles of chemistry and physics applied to energy conversion, types of engines, heaters and other devices, and to chemical and nuclear fuels and their different sources.

**3292. URBAN PROBLEMS— GEOGRAPHIC PERSPECTIVES.** (5 cr)
Focus on Twin Cities metro area with emphasis on the two central cities. Historical development perceived within context of physical environment. Efforts to centralize decision making and such current issues as population, housing, nonresidential land use, transportation, employment and income, city finances, urban renewal, and recreational land use.

# Genetics and Cell Biology (GCB)

College of Biological Sciences
250 Biological Sciences Center

**3002s. HUMAN GENETICS, SOCIAL AFFAIRS.** (3/4 cr, §3022, §Biol 1101, Biol 3032; for students in programs not directly related to biological sciences) Anderson
Human genetics; study of individuals, families, populations, and races with respect to differences in intelligence, behavior, disease, and other matters of social concern. For students in programs not directly related to the biological sciences.

**3008. THE BIOLOGY OF CANCER.** (3 cr; prereq Biol 1011) McKinnell
Biological aspects of etiology, phylogeny, and cellular processes involved in neoplasia. Growth and differentiation of normal and cancer cells. The history of cancer research.

**5042. POPULATION, QUANTITATIVE GENETICS.** (3 cr; S-N only, prereq 5033...Stat 5301 recommended) Comstock
Selection with reference to population changes in gene frequencies and means of quantitative characters. Information required for predicting effects of selection and related research. Emphasis on logical analysis.

**5063. THEORETICAL POPULATION GENETICS.** (3 cr; prereq 5033 or #, familiarity with differential and integral calculus) Simmons
Population genetic theory as related to problems of natural populations.

# Geography (Geog)

College of Liberal Arts
414 Social Sciences
CONTACT: R. Skaggs, 568 Social Sciences, 373-5774

**1401. PHYSICAL GEOGRAPHY.** (5 cr, §NSci 1501)
Distribution patterns of climate, relief, vegetation, and soils; regional differences in problems of physical development.

**1425. INTRODUCTION TO METEOROLOGY.** (4 cr, §Soil 1262) Baker, Skaggs
(Same as Soil 1262) Precalculus introduction to nature of the atmosphere and its behavior. Topics include atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observation; plotting and analysis of maps; forecasting.

**3101. GEOGRAPHY OF THE UNITED STATES AND CANADA.** (4 cr) Borchert, Hart
The manner in which abilities of different peoples have interacted with the natural environment in producing regional differentiation in United States and Canada.

**3111. GEOGRAPHY OF MINNESOTA.** (4 cr)
Physical resources, population, and commercial production. Field trips in eastern Minnesota.

**3343w. LAND USE ECOLOGY.** (4 cr) Squires
Study of the human being as an animal; ecological principles of human existence and use of the earth.

**3355. ENVIRONMENTAL PROBLEMS.** (4 cr) Gersmehl, Squires
Environmental problems associated with human activities.

**3361. ENVIRONMENTAL EVALUATION AND ADAPTATION.** (4 cr) Tuan
The making of "worlds" out of "environments"; how different peoples evaluate and adapt to their natural surroundings, past and nonliterate cultures.

**3371w,s. URBAN GEOGRAPHY.** (4 cr) J Adams
Character, distribution, and development of cities in present-day world. Internal and external locational relationships.

**3421. CLIMATOLOGY.** (4 cr; prereq 1401 or #) Skaggs, Barrett
World distribution of climatic elements; methods of arranging climatic data; climatic classifications and world distributions of climatic types; general circulation; climatic change and climatic fluctuations.

**3431. PLANT AND ANIMAL GEOGRAPHY.** (4 cr) Squires
Distribution of plants and animals on the earth. Emphasis on geographical factors (climate, land and sea distribution, soil) and biological factors (dispersal, evolution, competition) responsible for this distribution.

**3973. GEOGRAPHY OF THE TWIN CITIES. (4 cr;** §1973) Staff
Major social and physical characteristics of the Twin Cities and their place in the urban network of the United States.

**5372-5373. METROPOLITAN ANALYSIS I, II.** (4 cr per qtr) J Adams
5372: Urban systems and metropolitan areas, structure and growth; daily urban systems; simulated urban systems; metropolitan population dynamics; social area analysis; transportation systems; travel behavior; land use; retail structure, change. 5373: Neighborhood transition; conflicts in housing, location of facilities, and urban renewal.

**5375-5376. AMERICAN CITIES— LOCATION AND GEOGRAPHIC DESIGN.** (4 cr per qtr; prereq #) Borchert
5375: The spread of urbanization across the United States; differentiation of city sizes and functions within the nation's resource regions and circulation network; the evolution of today's system of cities and its regional and national management problems. 5376: The internal development of the major metropolitan areas of the United States; evolution of today's land-use patterns, activity systems, and metropolitan management problems.

**5381. SERVICES AND LOCATION THEORY.** (4 cr; prereq 4 cr econ geog or econ or #) R Adams
Localization of economic activity; case studies of industries and services; location factors, models, and theory.

**5383s. TRANSPORTATION GEOGRAPHY.** (4 cr; prereq 3331 or #) R Adams
Principles and theory of spatial development of transport systems; interaction of resource use and network growth; commodity and passenger flows; case studies at national, regional, and local (urban) levels.

**5391s. RURAL GEOGRAPHY.** (4 cr) Mather
Geographic components and assemblages of rural settlement. World patterns and geographic problems of rural settlement in the United States.

**5424. QUATERNARY CLIMATES.** (4 cr; prereq #) Skaggs, Squires
Climatic variability during the Quaternary period; the evidence for, and significance of, such variability.

**5445. QUATERNARY PALEOGEOGRAPHY.** (4 cr) Squires
Evidence of past environments with special reference to the Quaternary period.

**5811. ENVIRONMENTALISM, ENVIRONMENT, AND THE QUALITY OF LIFE.** (4 cr; prereq #) Tuan
Ideas of environmentalism; organization of the physical environment into rural and urban settings that reflect human ideals.

**5849. SPACE AND PLACE: A GEOGRAPHY OF EXPERIENCE.** (4 cr) Tuan
How experience creates structure and meaning in space and environment.

**8340. SEMINAR: LAND USE PLANNING.** (3 cr; prereq #) J Adams, Borchert

**8410. PHYSICAL ENVIRONMENT PROBLEMS IN METROPOLITAN AREAS.** (3 cr; prereq #)

**8440. PLEISTOCENE BIOGEOGRAPHY.** (1-3 cr) Squires

**8850. SEMINAR: ATTITUDES TOWARD ENVIRONMENT.** (3 cr; prereq #) Tuan

# Geology and Geophysics (Geo)

Institute of Technology
108 Pillsbury Hall
CONTACT: H. O. Pfannkuch, 2d Pillsbury Hall, 373-5678

**1001f,w,s. PHYSICAL GEOLOGY.** (5 cr; high school physics and chemistry recommended; 3 lect hrs, one 2-hr lab, 1 rec hr per wk)
A first course in geology for science majors, and an introduction to scientific method and nature of the earth for others. Survey; main features of physical world and processes that have formed them.

**1002f,w,s. HISTORICAL GEOLOGY.** (4 cr; prereq 1001; 3 lect hrs and one 2-hr lab per wk) Sloan
Evolution of earth from its origin to present; the succession of physical and biological events of past 600 million years.

**1007. ENVIRONMENTAL GEOLOGY.** (4 cr, §1008; prereq 1001) Wright
Geological applications in resource management, land use planning, technology, and conservation. Geological evolution of the biosphere and the impact of human activities on land, sea, and air resources. Geological hazards. The Twin Cities metropolitan area as a geological environment. Lectures, labs, and field trips.

**1008. GEOLOGY AND MAN.** (4 cr, §1007) Shaw
Human existence in the physical environment: geological hazards (e.g., earthquakes); the nature and use of natural resources; geological aspects of pollution, recreation, and land use; the effect of the composition of rocks and soils on nutrition and disease. An introduction to the broad nature of earth science. Lecture, labs, and field trips.

**1012. EARTH AS A PLANET.** (4 cr) Murthy
The origin and evolution of the earth, its structure and composition in relation to other planets, and the cosmic abundances and mode of formation of elements in the solar system.

**1013. ORIGIN AND EVOLUTION OF LIFE.** (4 cr) Sloan
Geological evidence of the origin and increasing complexity of living systems, including biogenesis, single-celled organisms, plants, animals, and ecosystems. Problems of extraterrestrial life.

**1601. OCEANOGRAPHY.** (4 cr)
Survey of marine sciences including marine geology, marine biology, physical and chemical oceanography, resources of the sea, and human interaction with the sea.

**3101f. SURFICIAL GEOLOGIC PROCESSES.** (5 cr; prereq 3102, 3401 or #) Hooke, Pfannkuch, Johnson
Geological processes acting at the surface of the earth. Geomorphology, limnology, groundwater geology, and sedimentology. Field trips.

**5108. ADVANCED ENVIRONMENTAL GEOLOGY.** (4 cr; prereq geology core curriculum 1111 through 3103 or equiv) Parham
Human impact on the geological environment and the effect of geology/geologic processes on human life. Land use planning; geologic hazards; geologic aspects of health and disease; mineral conservation; waste disposal; and geologic controls and limitations in developed versus underdeveloped countries.

**5261. GLACIAL GEOLOGY.** (4 cr [5 cr with term paper]; prereq 1002 or 3112) Wright
Formation and characteristics of modern glaciers; erosional and depositional features of Pleistocene glaciers; history of Quaternary environmental changes in glaciated and nonglaciated areas. Field trips.

**5601. LIMNOLOGY.** (4 cr, §EBB 5601; prereq Chem 1005 or equiv and #) Shapiro
Description and analysis of events occurring in lakes, reserviors, and ponds, beginning with their origins and progressing through study of their physics, chemistry, and biology. Interrelationships of these parameters and effects of civilization on lakes. Field trips.

**5602. CASE STUDIES IN LIMNOLOGY.** (3 cr; prereq 5601 or EBB 5601 and #)
Detailed analysis of specific studies on lakes and their problems throughout the world.

**5611. GROUNDWATER GEOLOGY.** (4 cr; prereq 1001 or 1111, Math 1231, 1 qtr physics and chemistry, or #) Pfannkuch
Origin, occurence, and movements of groundwater. Characteristics of major aquifers and aquitards. Exploratory investigations. Hydrogeologic units and boundaries. Principles and theoretical aspects of recharge. Quality of groundwater supplies.

**5642. MARINE GEOLOGY.** (4 cr; prereq geology core courses or #) Johnson, Chase
Physiography and structure of ocean basins and continental margins; their development as suggested by concepts of global tectonics. Geologic processes within the marine environment. Review of marine geological and geophysical techniques.

**8098. SEMINAR: CURRENT TOPICS IN GEOLOGY AND GEOPHYSICS.** (1-6 cr; prereq #)

**8099. RESEARCH IN GEOLOGY AND GEOPHYSICS.** (1-6 cr; prereq #)

**8612. ANALYTICAL GEOHYDROLOGY.** (3 or 4 cr; prereq Math 3211, CE 3400 or #) Pfannkuch

# History of Science and Technology (HSci)

Institute of Technology
428 Physics
CONTACT: Roger H. Steuwer, 428 Physics, 376-7023

**1711, 1712, 1713. TECHNOLOGY AND WESTERN CIVILIZATION: ANCIENT, MEDIEVAL.** (4 cr per qtr, §3711, §3712, §3713) Layton

History and sociocultural relations of Western technology. 1711: The relations of technology to culture from the Bronze Age to the Middle Ages. 1712: Technology and science in the Renaissance; technology and the scientific revolution; emergence of industrialism. 1713: Diffusion of the industrial revolution, technological development and its impact on industry, government, and society of the 19th and 20th centuries.

**1811, 1812, 1813. INTRODUCTION TO HISTORY OF SCIENCE: RENAISSANCE TO INDUSTRIAL REVOLUTION.** (4 cr per qtr, §3811, §3812, § 3813) Shapiro

1811: Babylonian and Egyptian science; Greek natural philosophy, mathematics, astronomy, and biology, the Aristotelian world; decline and transmission of Greek science. 1812: Medieval background; the scientific revolution; the "experimental philosophy": dissecting and describing nature; anatomy, circulation, and respiration; Copernican revolution; physical world of Kepler, Galileo, Descartes, and Newton; science and the popular imagination. 1813: 19th and 20th centuries; Newtonian triumph, romantic reaction, and modern revolution; the aether, electrical and optical, to Einstein; history of the earth; evolution before and after Darwin; nuclear physics and nuclear weapons.

**3201, 3202, 3203. HISTORY OF BIOLOGY.** (4 cr per qtr, §5201, §5202, §5203)

3201: Antiquity to 1700. Biology, medicine, and natural history in antiquity: Hippocrates, Aristotle, Galen. Revival of biology in Renaissance and 17th century: Vesalius and anatomy, Harvey and circulation. 3202: Physiology and cell theory since 1700. Conceptual development of the various branches of modern biology: physiology, chemistry, and the experimental method; embryology, descriptive and experimental; cytology and microscopy. 3203: Evolution and genetics since 1700. Darwin and evolution; Mendel and genetics; biology and society, race and eugenics.

# Horticultural Science (Hort)

College of Agriculture
305 Horticultural Science
CONTACT: D. White, 456 Alderman Hall, 373-0921

**1010. HOME HORTICULTURE.** (4 cr; not designed for landscape horticulture majors)
Working knowledge of propagation and culture of common house plants and landscape materials: turf, flowers, trees, and shrubs. Principles of home landscape design applied to a home property of the student's own choosing. Lectures, laboratory, and reference reading.

**1021. WOODY PLANT MATERIALS.** (4 cr)
Taxonomy, ecology, and landscape uses of trees, vines, evergreens, and native deciduous shrubs. Lectures, laboratories, and field trips.

**1022. HERBACEOUS PLANT MATERIALS.** (4 cr)
Taxonomy, ecology, and landscape uses of perennial and annual flowers, tender and hardy bulbs, ground covers, and selected deciduous shrubs. Lectures, laboratory, and field trips.

**1036. PLANT PROPAGATION.** (4 cr; prereq Biol 1103, Hort 1101 or #)
Principles and techniques of propagating plants by seeds, cuttings, grafts, buds, layers, and division. Lectures on principles; laboratories on practice of various propagating techniques; and field trips.

**3026. RESIDENTIAL LANDSCAPE DESIGN.** (4 cr; prereq 1021, LA 1025)
Principles of landscape design with reference to their practical application in planning of residential landscapes. Relationships of landscape design, architectural design, and interior design. Landscape drafting techniques and methods of presentation. Lectures, drawings, and practical problems.

**3031. FRUIT SCIENCE.** (4 cr; prereq 1001, Soil 1122)
Principles of fruit production. Fruits of the world with emphasis on temperate climate crops. Site selection, cultural and management practices, physiological and environmental control of plant development, dwarfing, growth regulating compounds, insecticides, and herbicides. Lectures and laboratory.

**3032. VEGETABLE SCIENCE.** (4 cr; prereq 1001, Soil 1122)
Principles of vegetable agriculture including world food problems, geography of production, nature and scope of fresh vegetable and processing industries, physiological adaptation of species as food sources and such principles of production practice as stand establishment, irrigation, nutrition, seed production, and postharvest handling. Lectures, discussion, and laboratory practice in field and greenhouse.

**3053. ORNAMENTALS FOR INTERIOR DESIGN.** (4 cr)
Identification, utilization, and culture primarily of foliage plants used in interior decoration. Lectures, reference reading, and field trips.

**3072. TURF MANAGEMENT.** (4 cr; prereq 1001 and Soil 1122 or Agro 1010 or Biol 1103)
General landscape maintenance and turf culture. Working in areas of industrial grounds maintenance, park and recreation area maintenance, and general lawn care.

**3076. ARBORICULTURE.** (3 cr; prereq 1021, Soil 1122, or FBio 1100 or #)
Survey of environmental and design function of shade trees. Application of specific cultural principles and techniques pertaining to the installation, maintenance, and preservation of shade and ornamental trees. Equipment selection and adaptability. Fundamental concepts used in the organization and administration of community shade tree programs. Lectures, demonstrations, and field trips.

# Humanities Program (Hum)

College of Liberal Arts
314 Ford Hall
CONTACT: Robert Tapp, 310 Ford Hall, 373-3516

**3049. SCIENCE AND HUMANITIES.** (5 cr; prereq jr, sr, or #)
"Warfare" between the scientific and humanistic cultures; documents from Ficino and Vives to Polanyi, Koestler, Bronowski, and A. Huxley. Humanistic scholarship and methodological character of sciences, creativity in arts and sciences, science and human values.

**3101f, 3102w, 3103s. THE MEANING OF HUMANITY: SOCIETY AND TECHNOLOGY, COMMUNITY.** (4 cr per qtr) Roshwald
3101: The essence of humanity and the factors determining its course; theories such as those of Marx, Freud, Plato. 3102: Impact of technology on human conditions; the attitude of people toward technology, examined philosophically and sociologically. 3103: Meaning of people as social beings and the groups in which they participate.

# International Relations (IntR)

College of Liberal Arts
CONTACT: Robert T. Kudrle, 1246A Social Sciences

**5802. THE PROSPECTIVE WORLD ECONOMY.** (4 cr; Econ 5421; prereq Econ 5401 or 5431 or #) Smith
Alternative patterns for a future world economy, implications for economic welfare of nations. World institutions and their relation to growth and survival problems in a world economy.

**5803. THE STEADY STATE EARTH.** (4 cr) Blackshear
Constraints imposed on the options available in human society by physical factors.

**5831. ANALYSIS OF WORLD FUTURES MODELS.** (4 cr; prereq #) Job
Continued growth and depletion of global resources; "quantitative models" to analyze large social systems; world futures models; projections of future world states; alternatives and limitations.

# Journalism and Mass Communication (Jour)

College of Liberal Arts
111 Murphy Hall
CONTACT: P. Tichenor, 35 Murphy Hall, 376-7104

**5133. SCIENCE COMMUNICATION.** (4 cr; prereq 3121 or 3176 for majors...# for nonmajors) Tichenor
Role of journalistic communication in science; scientist-journalist relationships; communicating results of scientific investigations to public, specialized audiences, industry.

**5143. INTERPRETATION OF SCIENCE AND TECHNOLOGY.** (4 cr; prereq 5133, 5501 or #) Tichenor
Analysis of scientific research and technological development for mass and specialized media; science content in media; audience impact.

**5144. URBAN JOURNALISM.** (4 cr; prereq 3121, 5131, or grad student, professional experience, #, or △) Ismach
Urban problems and mass media role and performance; specialized reporting and commentary on urban functions; urban media policy and news gathering techniques; analysis of media content; reporting projects on urban and environmental subjects and appropriate readings.

**5501f,s. COMMUNICATION AND PUBLIC OPINION I.** (4 cr, §Soc 5355; prereq 15 cr in social science depts) Carter, Tichenor, Wackman
Theories of the communication process and of persuasion and attitude change. Interpersonal and mediated communication in diffusion of information and in opinion formation.

**5531w. COMMUNICATION AND PUBLIC OPINION II.** (5 cr; prereq 5501 or Soc 5355) Carter, Tichenor, Wackman
Theories and research findings on opinion formation, persuasion, diffusion of information. Social science contributions to studies of the process and effects of mass communication. Focus is on field research methods, both theory and practice.

**5721w,s. MASS MEDIA IN A DYNAMIC SOCIETY.** (4 cr; prereq 1201 or 3121 for journalism majors...# for others) Dennis, Gillmor, Ismach, Ward
Economic, political and social determinants of character and content of mass communications. Patterns of operations, effect on content, and relative social utility. Theory of mass society.

# Landscape Architecture

See ARCHITECTURE AND LANDSCAPE ARCHITECTURE

# Large Animal Clinical Sciences (LACS)

College of Veterinary Medicine

301 Veterinary Science

**3502. ANIMAL HEALTH AND DISEASE.** (5 cr; courses in general chemistry, microbiology, and introductory biology or zoology helpful)

Designed for nonveterinary students, to give a broad understanding of veterinary science as it applies to the health and disease of domestic animals. Emphasis on basic concepts of disease and common animal diseases that demonstrate these concepts. How stress and management practices aggravate and create new disease conditions.

# Law School (Law)

285 Law Building

CONTACT: Marcia Gelpe, 316 Law, 376-7234

**5215. ENVIRONMENTAL REGULATION.** (3 cr; prereq △) Gelpe

Legal aspects of major environmental problems with emphasis on issues that reappear in various regulatory contexts: e.g., who should bear the cost of enhancing environmental quality; allocation of responsibilities among courts, legislatures, and administrative agencies; role of citizens groups and environmental litigation; environmental policy acts.

**5885. SEMINAR: ENVIRONMENTAL REGULATIONS.** (3 cr; prereq △) Gelpe

Subject matter varies; each year involves in-depth examination of literature on one topic and paper applying analysis developed from literature and discussion to current problems. Designed for graduate students in environmentally related areas as well as for law students.

# Mechanical and Aerospace Engineering, School of (SMAE)

Institute of Technology

125 Mechanical Engineering

CONTACT: K. T. Whitby, 130 Mechanical Engineering, 373-3049

**5710, 5711. TRANSIT SYSTEMS ANALYSIS AND DESIGN.** (4 cr; prereq sr engineering status or #; 4 lect hrs per wk)

Basic performance relationships, analysis of performance of specific systems, theory of curved guideways, cost of effectiveness, parametric analysis of patronage, requirements for safe operation, longitudinal control of automated transit systems, life-cycle cost, failure modes and effects analysis, reliability requirements, optimization of guideway structures. System synthesis for maximum cost effectiveness and practice in design of specific systems.

# Mechanical Engineering (ME)

Institute of Technology

125 Mechanical Engineering

CONTACTS: K. T. Whitby, 130 Mechanical Engineering, 373-3049, or instructor listed

**3402. ECOLOGY, TECHNOLOGY, AND SOCIETY.** (4 cr, §SSci 3402; 4 lect and 1 rec hr per wk)

Problems of population growth, resource depletion, and pollution. Impacts on health, social values, technological change, and institutions. Presentations by 20 lecturers from various disciplines, integrative discussions and exercises.

**5603. THERMAL ENVIRONMENTAL ENGINEERING.** (4 cr; prereq 3303, 5342; 4 lect hrs per wk) Threlkeld

Thermodynamic properties of moist air; h-w diagram for moist air; solar radiation; heat and water vapor transmission in structures; effects of thermal environments upon people, processes, and materials; thermal loads, thermal environmental control systems.

**5607. INDUSTRIAL VENTILATION AND CONTAMINANT CONTROL.** (4 cr; prereq 3303, CE 3400; 4 lect hrs per wk) Whitby

Contaminants, dispersion mechanisms, transport, fans, hoods, gas cleaners, behavior of jets and sinks, closed and open systems, applications to industrial processing and emission control.

**5612. ENVIRONMENTAL ENGINEERING.** (4 cr; prereq jr or sr in IT or #: 4 lect hrs per wk) Whitby
Basic principles of engineering assessment and control of emissions to air and water, noise measurement and control, and control, handling, and disposal of solid wastes.

**5613. PRINCIPLES OF PARTICLE TECHNOLOGY.** (4 cr; 3303 recommended; 4 lect hrs per wk) Liu
Definition, theory, and measurement of particle properties, particle statistics, fluid dynamics, optical, electrical and thermal behavior of particles.

**5614. PRINCIPLES OF PARTICLE TECHNOLOGY.** (4 cr; prereq 5613; 4 lect hrs per wk) Liu
Gas cleaning, particle transport, comminution, classification, surface properties, packed beds, powder behavior, and miscellaneous topics.

**5615. AIR CONTAMINANT MEASUREMENT.** ( 4 cr; prereq 5613 or #) Whitby
Principles of operation, application and interpretation of data from instruments and instrument systems used for in-plant contaminants, emissions and air quality measurement. Part lecture and part laboratory.

**5712. SOLAR ENERGY UTILIZATION.** (4 cr; prereq 5342 or #) Liu
History and potential of solar energy utilization; availability of solar radiation on clear and cloudy days; incident radiation on horizontal, vertical, and inclined surfaces; flat-plate and concentrating solar collectors; heating and cooling with solar energy; power generation; review of current research.

**5721. PROPULSIVE SYSTEMS FOR SURFACE TRANSPORTATION.** (4 cr; intended for engineering srs; 3301 recommended; 4 lect hrs per wk)
Characteristics of electrical and mechanical propulsion devices and energy storage systems available for use in various types of surface transport vehicles, worldwide energy sources, environmental implications of transport propulsive devices, power requirements, and thermodynamic constraints.

## Microbiology (MicB)

College of Biological Sciences and Medical School
1060 Mayo Memorial Building

**3103. GENERAL MICROBIOLOGY.** (5 cr; prereq soph with C avg in prereq courses to major sequence, or jr with 10 cr in chemistry and 5 cr in biological sciences or #) Schmidt
Morphology, physiology, taxonomy, and ecology of bacteria. Practical applications of fundamental principles.

**5105. BIOLOGY OF MICROORGANISMS.** (4 cr, §3103, §Biol 3013; prereq 5 cr in biological sciences, Biol 3021 or #) Dworkin
Taxonomy, anatomy, physiology, biochemistry, and ecology of microbes. Molecular structure in relation to bacterial function. Lectures, demonstrations, and laboratory exercises.

**5611. MICROBIAL ECOLOGY.** (4 cr; prereq general microbiology course, Biol 3021 or #) Crawford
Microbial adaptation and diversity; role of microorganisms in natural processes; methods in microbial ecology; other topics.

## Mineral Engineering (MinE)

Institute of Technology
112 Mines and Metallurgy
CONTACT: N. F. Schulz, Mineral Resources Research Center, 373-3341

**5630. SURFACE MINING ENGINEERING.** (4 cr; prereq Geo 1111, MinE 5611 or #)
Unit operations of drilling, blasting, loading, hauling, and transporting of surface rocks and soils. Equipment productivity, selection, and cost estimating. Design of open pits and quarries. Economics, environment, and organization.

**5710. ENVIRONMENTAL ASPECTS OF MINERAL ENGINEERING.** (4 cr; prereq 3rd yr IT or #; 4 lect hrs per wk)
Recognizing and minimizing the environmental problems posed by mining and metallurgical operations in both the immediate working environment and the larger ecological environment. Only a limited number of students from outside the department can be accommodated.

## Natural Science (NSci)

College of Liberal Arts
106 Johnston Hall
CONTACT: Director, Cross-Disciplinary Studies, 106 Johnston, 373-5069

**3101. INTRODUCTION TO ENVIRONMENTAL TECHNOLOGY.** (4 cr; prereq high school physics or chemistry)
Technological aspects of protecting humans and the environment from human activities. Sources and magnitude of pollution problems in air, water, noise, solid waste. Environmental quality standards, pollution abatement options, technological limitations.

**3301. ENERGY, POWER, AND SOCIETY.** (4 cr; prereq high school algebra, physics, or chemistry)
The need for energy and its use in society. Concepts of energy and power; problems of pollution and waste disposal.

## Pharmacology (Phcl)

Medical School
105 Millard Hall
CONTACT: M. W. Anders, 105 Millard Hall, 373-5112

**8214s. TOXICOLOGY.** (3 cr; prereq MdBc 5101 or equiv, or #; offered 1979-80 and alt yrs)
Lectures on the toxic effects and mechanisms of intoxication of drugs and foreign chemicals known to adversely alter human and animal health and ecology.

## Philosophy (Phil)

College of Liberal Arts
355 Ford Hall
CONTACT: Rolf Sartorius, 381 Ford Hall, 373-3893

**3303. ETHICS, POPULATION, AND ENVIRONMENT.** (5 cr) Sartorius
Moral and political theoretical problems associated with population and environmental policy proposals.

## Physics (Phys)

Institute of Technology
148 Physics
CONTACTS: Homer Mantis, 359 Physics, 373-5474
Konrad Mauersberger, 42A Physics, 373-5458

**1071. INTRODUCTORY METEOROLOGY.** (4 cr; prereq high school algebra and trigonometry; 5 lect hrs per wk)
Physics of atmospheric processes. Clouds, fronts, and cyclones. Weather forecasting. Human influence on the atmosphere.

**1075. INTRODUCTORY METEOROLOGY LABORATORY.** (1 cr; S-N only; prereq 1071 or ¶1071; 2 lab hrs per wk)
Field experiments offered in conjunction with 1071.

**5441. INTRODUCTORY DYNAMIC METEOROLOGY I.** (5 cr; prereq 1291 and Math 3231 or 5602 or #; 3 lect and 3 lab hrs per wk)
Fluid dynamics of large-scale weather systems; mathematical introduction to quasi-geostrophic model used in numerical weather prediction. Concurrent laboratory study of weather charts to illustrate application of theory offered.

**5442. INTRODUCTORY DYNAMIC METEOROLOGY II.** (4 cr; prereq 5441 or #)
Energetics and general circulation of the atmosphere.

**5461. PHYSICS AND CHEMISTRY OF THE EARTH'S UPPER ATMOSPHERE.** (4 cr; prereq general physics, calculus)
Survey of atmosphere above 15 km; physics and chemistry of the stratosphere, mesosphere, and thermosphere; temperature and density profiles; major and minor constituents and their distributions; aspects of pollutants; reactions and rates; global variation of constituents; the energy budget of the atmosphere.

## Plant Pathology (PlPa)

College of Agriculture
304 Plant Pathology

**1001f,w. INTRODUCTORY PLANT PATHOLOGY.** (5 cr, §5050; prereq soph, 9 cr plant science)
Introductory course in plant diseases. Lectures, laboratory, and special problems.

**3102w. ABIOTIC DISEASES OF PLANTS.** (4 cr; prereq 1001 or 5002, PlPh 5184 and Soil 1122, or #; offered 1979 and alt yrs)
Diagnosis, etiology, and control of plant diseases caused by adverse physicochemical factors. Effects on plants of temperature, moisture, light, agrochemicals, nutritional disorders, and air pollutants.

**5002f,w. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS.** (3 cr, §1001, §5050; prereq 14 cr plant sciences or #)
General plant pathology.

**5050s. FOREST PATHOLOGY.** (4 cr, §1001; prereq Biol 1103 or equiv)
Diseases of forest and shade trees; wood decay. Symptoms, etiology, and control. Lectures, laboratory, and fieldwork.

**5110w. AIR POLLUTION AND ITS EFFECTS ON VEGETATION.** (4 cr; prereq 10 cr biology or #)
Types of air pollutants, sources and dispersal, meteorology, pollutants in rain and aerosols, field investigation techniques, effects on vegetation including communities, control of injury to plants, air quality criteria, case histories.

# Political Science (Pol)

College of Liberal Arts
1414 Social Sciences Building
CONTACTS: Samuel Krislov, 1414 Social Sciences, 373-2651
C. Backstrom, 1380 Social Sciences, 373-2686

**5322. AMERICAN SOCIAL POLICY.** (4 cr; prereq 1001 or #) Eyestone
American government actions affecting the distribution of social benefits such as health care, education, and housing; social burdens such as taxation and regulation of social conduct. Relationships between government action and social problems; possibilities for change.

**5328. METROPOLITAN GOVERNMENT AND POLITICS.** (4 cr; prereq 1001 or #) Nimtz, Scott
Development of the modern American metropolis; central cities and suburbs; intergovernmental relationships in the metropolis; state and federal responses to metropolitan problems; politics of reforming metropolitan government.

# Public Affairs (PA)

(Hubert H. Humphrey Institute)
College of Liberal Arts
909 Social Sciences Building
CONTACT: D. E. Abrahamson, 967 Social Sciences, 373-7796

**3121. INTRODUCTION TO PUBLIC INTEREST RESEARCH.** (4 cr, §5121) Abrahamson
Public interest activities, particularly as they relate to environmental, consumer, and public health issues. Public interest law; case studies of local and national public issues.

**3151. INTRODUCTION TO ENERGY POLICY.** (4 cr, §5151) Abrahamson
The energy crisis. Energy supply and demand, alternative energy sources, energy conservation possibilities, environmental and social implications of alternative policies. Current energy policy issues.

**5121. PUBLIC INTEREST RESEARCH AND PRACTICE.** (4 cr, §3121; prereq #) Abrahamson
Public interest groups— their origins, methods of operation, and activities. Consumer and environmental topics, public interest legal activities, policy analysis using environmental impact statements, regulatory agencies. Student research and review papers.

**5151. ENERGY AND ENERGY POLICY.** (4 cr; §3151; prereq #) Abrahamson
Fuel and energy supply and demand; environmental, social, and economic implications of alternative energy policies; means to effect changes in use patterns; political and institutional factors; relation of energy policy to economic, foreign, and environmental policies.

**5152. TOPICS IN ENERGY POLICY.** (4 cr; prereq 5151 or #) Abrahamson, Geesaman
Topic selected each year on the basis of current activities in state, federal, or international energy policy.

**5161, 5162. TECHNOLOGY PLANNING I, II.** (4 cr per qtr; prereq # for 5161...5161 for 5162) Geesaman
Relationship of science and technology to the ideological bases of society; technology's significance in the policy process; society's institutions for governing its technologies.

**5181. POLICY TOPICS IN COMMUNICATIONAL AND INFORMATIONAL TECHNOLOGIES.** (3 cr; prereq #) Geesaman, Dewar
Contemporary topics selected for political and social significance. Related technologies and their economic and political importance; related policies and institutional controls.

# Resource and Community Development (RCD)

College of Agriculture

CONTACT: D. White, 456 Alderman Hall, 373-0921

**1010. ISSUES IN THE ENVIRONMENT.** (3 cr) R Adams, Jr
Interdisciplinary offerings designed to explore five areas of environmental concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 20 taped lectures and 10 discussion periods. Cooperative offering available at several other Minnesota institutions.

**3010. THE MINNESOTA COMMUNITY: ANALYSIS OF ITS ORGANIZATION, CHANGE, AND DEVELOPMENT.** (4 cr; prereq one social science course and #)
Community problem solving and decision making. How local problems are defined, what communities can do in dealing with their problems, and how information (primarily scientific knowledge) may be applied to local problems. Conceptual analysis of communities and their problems. Secondary data analysis as a research technique for use in analysis of community problems in Minnesota.

**5120. ENVIRONMENTAL PROBLEMS.** (3 cr, §1010)
Interdisciplinary offering that examines the same five areas as RCD 1010. A televised course involving 22 taped lectures and 10 discussion periods. In addition, students prepare a report on a specific environmental problem. Offered only through Continuing Education and Extension.

**5200. COMMUNITY DEVELOPMENT SIMULATION.** (4 cr; prereq 9 cr in social science and #)
Simulation of regional activity systems and their environmental impacts. Playing community development game for decision makers in economic, social, and political sectors of model urban community.

# Rhetoric (Rhet)

College of Agriculture

202 Haecker Hall

**5600. TRANSFER OF TECHNOLOGY.** (4 cr; prereq one of the following: 5257, 5400, Jour 5133, or #)
(Same as AgJo 5600) Methods of transferring scientific and technical knowledge and practice from those individuals and organizations who possess it to those who need it. Review of research in diffusion and transfer methods at different technical levels. Tools, methodologies, and assessment procedures for an actual program of technical or scientific subject matter. Planning state-of-the-art or frontier technology seminars and impact analysis for scientists, engineers, and/or segments of the public required.

**5700. COMMUNICATION IN TECHNOLOGICAL AND ENVIRONMENTAL IMPACT ASSESSMENT.** (4 cr; prereq sr or grad, one course in statistics, and #)
Theories and processes involved in technological assessment and environmental impact statement preparation. Case studies of technology assessments, forecasts, and environmental impact statements. Term project on planning of process and project management in an actual impact assessment.

# Social Science (SSci)

College of Liberal Arts

106 Johnston Hall

CONTACT: Director, Cross-Disciplinary Studies, 106 Johnston Hall

**3402. ECOLOGY, TECHNOLOGY, AND SOCIETY.** (4 cr)
The impact of technology on society as seen by engineers, scientists, and social scientists. The social problems associated with economic growth such as environmental consequences, the arms race, food and fertilization, and population growth. Alternative strategies for meeting the problems.

# Social Work (SW)

College of Liberal Arts

400 Ford Hall

**3984f,w,s. INTRODUCTION TO COMMUNITY DEVELOPMENT.** (4 cr; prereq 1001 or #)
Trends, pace, and dynamics that dominate urban communities; strategies used to achieve neighborhood goals; factors that control and influence change in planning; action on the community level.

**8305. COMMUNITY DEVELOPMENT.** (3 cr)
Analysis of process by which groups and individuals within a community work together to express community need through social services; identification of principles in working with unifunctional and local organizations.

**8307. THEORIES OF SOCIAL PLANNING AND SOCIAL CHANGE.** (3 cr)
Analysis of principles of working with multifunctional, complex social structures in social planning, community action and development.

# Sociology (Soc)

College of Liberal Arts
1114 Social Sciences Building
CONTACT: Robert Kennedy, 1125 Social Sciences, 373-2610

**3551f,w. WORLD POPULATION PROBLEMS.** (4 cr) Kennedy
Population growth and natural resources, basic population dynamics, fertility and mortality in less developed and industrialized nations, population forecasts, policies to reduce fertility.

**5301. SOCIAL MOVEMENTS IN A CHANGING SOCIETY.** (4 cr; prereq 3201, 3401, 5201, or 5401 or equiv or #)
Factors underlying social change in modern mass society. Recent research on social movements, reform and revolution, culture contact, impact of rapid technological change. The individual and social structures under rapid social change.

**5311. SOCIOLOGY OF CONFLICT.** (4 cr; prereq 3401 or 5401 or equiv or #) Cooperman
Theoretical, empirical study of group conflict. Methods and models. Animal conflict. Aggression and conflict. Types of conflict: feuds, community, racial, ecologies of urban conflict, internal war, revolution. Conflict and social organization: relation of stratification, industrial and social change to conflict.

**5555s. POPULATION THEORY.** (4 cr; prereq honor cand, grad or #) Kennedy
Critical evaluation of what social science theory is, and a systematic evaluation of various writings in population as theoretical works.

**5601. URBAN SOCIOLOGY.** (4 cr; prereq 3401, 3405 or 5401 or equiv or #, some statistics recommended) Bradley, Cooperman, Stone
Cities, urban ecology; urban institutions and urban way of life.

**5605. URBANIZATION AND SOCIAL POLICY.** (4 cr; prereq 5601 or #) Cooperman
"Problematic" contemporary changes in urban processes; responses and policies of public groups. Interrelationships of social, cultural, economic, political factors in development of urban problems. Models of urban systems and social policy formation. Social cost analysis and formation of policy alternatives.

**5675. WORLD FOOD SUPPLY PROBLEMS.** (4 cr, §AgEc 5790, §FScN 5643, §PlPa 5220, §LACS 5280; prereq major in agriculture, veterinary medicine, nutritional sciences, social science or #...grad students △) Ellenbogen
Multidisciplinary approach to social, economic, and technical problems of feeding the world's growing population. Principles from social and economic sciences. The plant, animal, and nutritional sciences and their application to food problems.

**8308. MODERNIZATION AND SOCIAL CONFLICT: A CROSS-NATIONAL APPROACH.** (5 cr; prereq #) Ellenbogen

**8601, 8602. SEMINAR: RESEARCH IN URBAN SOCIOLOGY.** (3 cr per qtr) Stone

**8852, 8853. SEMINAR: METHODS FOR THE EVALUATION OF SOCIAL ACTION PROGRAMS.** (3 cr per qtr) Patton

# Soil Science (Soil)

College of Agriculture
125 Soil Science
CONTACT: Russell S. Adams, Jr., Soil Science, 373-1361

The Department of Soil Science has divided its environmentally related courses into two categories: those of primary environmental interest, which are indicated below with a double asterisk (**), and those of secondary environmental interest, which should be taken only by students with a major or minor in soil science.

**1122f,w,s.** ** **INTRODUCTORY SOIL SCIENCE.** (4 cr; prereq Chem 1001 or 1004) Arneman
Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility.

**1262f. INTRODUCTION TO METEOROLOGY.** (4 cr) Baker, Skaggs
(Same as Geog 1425) Precalculus introduction to nature of the atmosphere and its behavior. Atmospheric composition, structure, stability and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

**3118f. SEMINAR: SOIL POLLUTION AND PUBLIC POLICY.** (1 cr; S-N only; offered 1978 and alt yrs)
Round table discussions of assigned readings.

**3218w. SEMINAR: SOIL, WATER, IRRIGATION, AND TILLAGE.** (1 cr; S-N only; offered 1980 and alt yrs)
Round table discussions of assigned readings.

**3220. SOIL, WATER MANAGEMENT, AND CONSERVATION.** (3 cr; prereq 3210 or #)
Factors affecting soil and water losses. Effect of soil tillage methods and cropping systems on structure maintenance, erosion control, water storage, and infiltration. Techniques and organizations in soil and water conservation.

**3528f.** SEMINAR: USE AND INTERPRETATION OF SOIL SURVEYS.** (1 cr; S-N only; offered alt yrs) Arneman
Round table discussions on assigned readings.

**5114f,w,s,su I, su II.** SPECIAL PROBLEMS IN SOILS.** (1-5 cr [may be repeated for max 10 cr]; prereq 1122 or #)
Research, readings, instruction.

**5240. MICROCLIMATOLOGY.** (5 cr; prereq Math 1111, 10 cr in physics or #) Baker
Meteorology and climatology in relation to soil-atmosphere interface; soil microclimate, physical processes taking place within the microclimate, modification of microclimate by agricultural practices. Weather instruments and use of climatic data.

**5340f.** ORGANIC AND PESTICIDAL RESIDUES.** (5 cr; prereq 1122, sr or #) R S Adams
The fate of natural and synthetic organic materials in soil, with emphasis on the chemical, physical, and biological factors of the soil that influence decomposition or persistence. Soil pollution from crop residues, animal wastes, sewage, petroleum hydrocarbons, detergents, and pesticides.

**5512s. SOIL GEOGRAPHY.** (4 cr; prereq 1122) Farnham
Introduction to soil morphology and classification essential to understanding distribution patterns of soils. Emphasis on soil geography of the state, region, United States, and world. Interpretation of this geography with the use of soil maps and aerial photographs of various types of resource development. Lectures, laboratories, field trips.

**5532s,su I.** SOILS AND THE ECOSYSTEM.** (5 cr, §EBB 5819; prereq course in ecology; Itasca offered 1979 and alt yrs) Grigal
Functional and structural aspects of soils as a component of the ecosystem. interrelationships of soils and vegetation on the landscape.

**5540.** SOIL RESOURCES AND ENVIRONMENTAL RELATIONSHIPS.** (4 cr; prereq 1122 or #) Hanson
Nutrient and contamination transfers through soil, water, and the atmosphere; specific soil-environmental quality relationships relating to residential and agricultural land use. A half-day field trip and seminar. Reports.

**5550w. ORGANIC SOILS.** (3 cr; prereq 1122) Farnham
Formation, classification, and properties of organic soils; their use and management. Lectures and laboratories.

**5632. SOIL MICROBIOLOGY AND PLANT GROWTH.** (4 cr, §5612; prereq 1122 and course in microbiology, or #) Hamm
The soil environment. Microbiological population of the soil. Role of microorganisms in the soil-plant environment and cyclic transformations of agronomic interests (C, N, and mineral substances). Effect of soil microflora on soil fertility and plant nutrition. Lectures and laboratory.

# Textiles and Clothing (TexC)

College of Home Economics
200 McNeal Hall
CONTACT: Robert F. Johnson, 354 McNeal Hall, 373-1696

**3623. PERFORMANCE EVALUATION OF TEXTILES.** (3 cr; prereq 3621)
Standard laboratory methods for rapid prediction of textile performance in the consumer environment; problems in specifying care procedures for labeling.

**5622. ISSUES AND TRENDS IN TEXTILE CONSUMER PROTECTION.** (3 cr)
The needs of the textile consumer for protection from deception and hazard; federal, state, and local legislation as well as voluntary industrial systems; case histories; change mechanisms.

**5626. RECYCLING PROCESSES.** (3 cr; prereq 5621)
Principles and practices in recovery of initial appearance and properties of textile products; application to restoration of historic textile materials; water pollution by effluent from wet cleaning processes.

**5662. CLOTHING CONSUMPTION PROBLEMS.** (3 cr; prereq 3621, AgEc 1030 or Econ 1002, Soc 1001, Psy 1001 or #)
Clothing problems as part of the consumption process of individuals and families; consequences of personal and socioeconomic conditions; impact of technology and public and private policy on the planning, acquisition, use, maintenance, and discard of clothing.

## Transportation (Tran)

College of Business Administration
334 Business Administration
CONTACT: D. V. Harper, 334 Business Administration, 373-3589

**3054. FUNDAMENTALS OF TRANSPORTATION.** (4 cr, §8154; prereq Econ 1002 or equiv)
Organization and economic aspects of transportation systems of the United States, including rail, highway, air, pipeline, and water. Administration of transportation by its users, carriers, and government.

**5194. GOVERNMENT PROMOTION OF TRANSPORTATION.** (4 cr; prereq 3054 or 8154 or #)
The need for, form of, administration of, and impact of government promotion and subsidy of rail, highway, air, water, and urban transportation in the United States.

**5195. GOVERNMENT ECONOMIC REGULATION OF TRANSPORTATION.** (4 cr; prereq 3054 or 8154)
The need for, form of, administration of, and impact of government economic regulations of rail, highway, air, pipeline, and water transportation in the United States.

## University College (UC)

105 Walter Library
CONTACT: Carol Greenwald, 105 Walter Library, 373-4638

**5501, 5502. PROBLEMS OF SCIENCE AND THE HUMANITIES.** (4 cr per qtr, approved for CLA credit) Penn
Historical and conceptual study of issues that may generate conflict between the sciences and humanities.

**5503. SCIENCE AND THE PROBLEM OF VALUE.** (3 cr) Penn
Is an ethic for scientists possible? Views of "moral neutralists" and "nonneutralists," and variations on these positions. Readings include Ravetz, Snow, Glass, Russell, Monod, Ellul, etc.

University College also offers directed studies registrations to students enrolled in the following UC programs: University Without Walls, Inter-College Program, and University Scholars. Contact these individual programs for more information.

## Urban Studies (UrbS)

College of Liberal Arts
527 Science Classroom Building
CONTACT: John S. Adams, 909 Social Sciences, 373-2653

**3101f, 3102w, 3103s. URBAN STUDIES COLLOQUIA.** (2 cr per qtr; S-N on; prereq #)
Introduction to urban problems and problem-solving techniques. Topics vary quarterly.

**3500f,w,s. WORKSHOPS.** (4 cr per qtr; prereq jr or sr, #) Staff
Project focused workshops, subjects vary quarterly. Seminar-discussions, research, or development of alternative models for solving urban problems.

**3900f,s. INTERNSHIP.** (1 to 12 cr; prereq jr, sr, and △) Staff
Internships may be arranged for any quarter or summer term. A weekly seminar to integrate the internship experience with the academic program should be taken during or immediately after the internship.

**3950. HONORS SEMINAR.** (Cr ar; prereq approval of Urban Studies honors representative)
Supervised investigation of selected topics.

**3970. DIRECTED STUDIES.** (Cr ar; prereq #)

## Veterinary Pathobiology (VPB)

College of Veterinary Medicine
239c Veterinary Science

**5603. PARASITES OF WILDLIFE.** (3 cr; prereq # [courses in introductory biology or zoology helpful]; offered 1979 and alt yrs)
Economic and biologic relationships of animal parasites and disease to regional wildlife.

**5604. DISEASES OF WILDLIFE.** (3 cr; prereq # [courses in introductory biology and zoology helpful]; offered 1978 and alt yrs)
Economic and biologic relationships of infectious and noninfectious diseases of wildlife.

## Zoology (Zool)

Department has been disbanded. Faculty and courses were transferred to Ecology and Behavioral Biology and to Genetics and Cell Biology.

## Extension Classes

Continuing Education and Extension

170 Wesbrook Hall

CONTACT: Beverly R. Sinniger, 180 Wesbrook Hall, 373-0115

Extension classes are scheduled in the evening on campus and in Twin Cities suburban area locations. Course listings, times, and locations are described in the Extension Classes Bulletin. Copies are available in 101 Wesbrook Hall or will be sent if you call 376-3000.

When no course descriptions are given, refer to the appropriate departmental listing in this bulletin.

**Anth 5117s. ENERGY, RESOURCE USE, AND SYSTEM CHANGE.** (5 cr; prereq 3201 or #; a joint day/extension class)

**Arch 1021f. HISTORY OF ENVIRONMENTAL DEVELOPMENT: ARCHITECTURE AND LANDSCAPE ARCHITECTURE.** (4 cr)

**Arch 1022w. HISTORY OF ENVIRONMENTAL DEVELOPMENT: ARCHITECTURE AND LANDSCAPE ARCHITECTURE.** (4 cr)

**Arch 1023s. HISTORY OF ENVIRONMENTAL DEVELOPMENT: PLANNING.** (4 cr)

**BGS 3003f. BUSINESS AND THE NATURAL ENVIRONMENT.** (4 cr; prereq at least jr standing for business degree students; may not be taken S-N)

**BGS 3004s. INTERNATIONAL BUSINESS.** (4 cr; prereq at least jr standing for business degree students)
World business with emphasis on the global economy, international concepts, global business structures, comparative cultures and environments, global business strategies, multinational corporations and technology, personnel and operations in the host nations. Resource (including energy) questions in their global contexts; quantities, demands, distribution of resources.

**BGS 3022f,w,s. BUSINESS AND SOCIETY.** (4 cr; prereq at least jr standing for business degree students; may not be taken S-N)

**Biol 1103s. GENERAL BOTANY.** (5 cr, §3012; prereq 1011 or #)

**Biol 1106w. GENERAL ZOOLOGY.** (5 cr; prereq 1011)

**Bot 1009s. MINNESOTA PLANT LIFE.** (4 cr)

**Bot 1012w. PLANTS USEFUL TO MAN.** (4 cr)

**Dsgn 5565w. HOMES OF THE WORLD.** (3 or 4 cr; prereq 1551 or 3563 or equiv; a joint day/extension class)

**EBB 3001w. INTRODUCTION TO ECOLOGY.** (4 cr, §Biol 1104; open to jr and above, or completion of 90 credits; not open to biology majors; also offered through Extension Independent Study)

**FR 5402w. INTERPRETATION AND MANAGEMENT OF FOREST ENVIRONMENTS.** (3 cr)
Biological foundations, biology of forest management, wildlife, hydrology, social and economic aspects, timber management and regulation, and recreation and amenity values. Intended for secondary school teachers and other interested students. Includes one Saturday field trip.

**FR 5403. FUNDAMENTALS OF NATURAL RESOURCE EDUCATION.** (3 cr)
For elementary teachers. Study of soil, water, forest and wildlife resources of Minnesota and the biological principles and ecological implications of management. Environmental issues developed through interactions of natural resource manipulation; outdoor teaching skills in environmental education in a metropolitan center.

**GC 1111w. SCIENCE IN CONTEXT: WEATHER AND CLIMATE.** (4 cr)

**GC 1112f,s. SCIENCE IN CONTEXT: HUMAN USES OF ENVIRONMENT.** (4 cr)

**GC 1113w. SCIENCE IN CONTEXT: NATURAL RESOURCES, THEIR UTILIZATION AND MANAGEMENT.** (5 cr)

**GC 1133s. NATURE STUDY.** (4 cr)

**GC 3114f. PERSONAL ENVIRONMENTAL HEALTH.** (4 cr; prereq 45 cr or #)

**GC 3134s. NATURE AND ITS IMPACT ON THE MIND.** (4 cr; prereq 45 cr or #; a joint day/extension class)

**GCB 3008. THE BIOLOGY OF CANCER.** (3 cr; prereq Biol 1011; fall semester)

**Geog 3111s. MINNESOTA.** (4 cr; a joint day/extension class)

**Geog 3345w. ENERGY AND MINERALS.** (4 cr)
Sources, production, circulation, and consumption of power, metals, and nonmetallic minerals. Problems of exhaustion, substitution, pollution, costs, trade, and policy. National and local case studies.

**Geog 3421s. CLIMATOLOGY.** (4 cr; prereq 1401 or #; a joint day/extension class)

**Hort 1010f,s. HOME HORTICULTURE.** (3 cr)

**Hort 1021s. WOODY PLANT MATERIALS.** (4 cr)

**Hort 1022s. HERBACEOUS PLANTS MATERIALS.** (4 cr)

**Hort 1036w. PLANT PROPAGATION.** (4 cr; prereq 1001, Biol 1103 or #)

**Hort 3026w. RESIDENTIAL LANDSCAPE DESIGN.** (4 cr; prereq 1021, LA 1024, or professional design experience)

**Hort 3032. VEGETABLE SCIENCE.** (3 cr; prereq 1010 or 1100)

**Hort 3076w. ARBORICULTURE.** (3 cr; prereq 1021, Soil 1122, or FBio 1100 or #)

**Hort 5042s. TURF GRASS SCIENCE.** (4 cr; prereq 3072, PlPa 1001, PlPh 3131)
For advanced students in turf with career objectives in professional turf management. All phases of the turf industry considered, with emphasis on the ecology, physiology, and theory of turf population dynamics and on specialized management situations such as golf course, commercial sod production, and fine turf athletic situations.

**LA 1024f. THEORY OF LANDSCAPE DESIGN.** (4 cr)

**ME 3402w. ECOLOGY, TECHNOLOGY, AND SOCIETY.** (4 cr, §SSci 3402)

**PA 3151w. INTRODUCTION TO ENERGY POLICY.** (4 cr, §5151; meets with 5151)

**PA 5151w. ENERGY AND ENERGY POLICY.** (4 cr, §3151; meets with 3151)

**PA 5152s. TOPICS IN ENERGY POLICY: NUCLEAR ENERGY.** (4 cr; prereq 5151 or #)

**PlPa 1000f. AN INTRODUCTION TO PLANT PATHOLOGY.** (2 cr, §1001)
Introduction to the characteristics of some of the more common diseases affecting annual and perennial ornamentals, foliage plants, fruits, and vegetables; the pathogens that cause those diseases and their control.

**PlPa 1002w. INTRODUCTORY PLANT PATHOLOGY— PATHOGENS.** (2 cr, §1001, §5003; prereq 9 cr plant science; PlPa 1002 and 1003 are equivalent to PlPa 1001; meets with 5003)
An introduction to the characteristics of the most important biotic and abiotic causes of plant diseases.

**PlPa 1003s. INTRODUCTORY PLANT PATHOLOGY: REPRESENTATIVE PLANT DISEASES.** (3 cr; prereq PlPa 1002; meets with 5004)
A study of representative plant diseases that are of significance in Minnesota.

**PlPa 5003w. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS: PATHOGENS.** (1 cr; prereq 14 cr plant science or #; meets with 1002; PlPa 5003 and 5004 are equivalent to PlPa 5002)
See 1002.

**PlPa 5004s. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS: REPRESENTATIVE PLANT DISEASES.** (2 cr, §1003, §5001; prereq 5003; meets with 1003)
See 1003.

**PubH 5171s. ENVIRONMENTAL MICROBIOLOGY.** (3 cr; prereq MicB 3101 or #)

**PubH 5181. INTRODUCTION TO AIR POLLUTION PROBLEMS.** (3 cr; prereq #; fall semester)

**PubH 5182. AIR POLLUTION CONTROLS AND SURVEYS.** (3 cr; prereq 5181 or #; spring semester)

**PubH 5241s. ENVIRONMENTAL HEALTH ASPECTS OF WATER SUPPLY.** (3 cr; prereq #)

**Soil 1122f. INTRODUCTORY SOIL SCIENCE.** (4 cr, §5022; prereq Chem 1001 or 1004 or equiv; meets with 5022)

**Soil 5114w. SPECIAL PROBLEMS IN SOILS.** (3 cr, §3420; prereq 1122)

**SSci 3402w. ECOLOGY, TECHNOLOGY, AND SOCIETY.** (4 cr, §ME 3402)

# SPECIAL CENTERS AND SERVICES

Many organizations in the Twin Cities participate in environmentally related activities. Although these various groups do not usually offer courses, they are frequently engaged in research and other projects in which interested students, faculty members, and others might become involved. In some cases students may obtain credit for work completed in such outside activities.

## All-University Council on Environmental Quality

Dean E. Abrahamson, Chairperson, 967 Social Sciences Building, 267 19th Avenue S., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-7796

The All-University Council on Environmental Quality was established in October 1971. Its rotating membership includes representatives from most colleges and campuses of the University.

The council is one of the first formal mechanisms at the University of Minnesota designed to further multidisciplinary and intercollegiate teaching, research, and public service activities. Specifically, the council's responsibilities and objectives lie in the following areas:

1. Information—The council gathers and disseminates information regarding the various environmentally related activities being carried on throughout the University. This guide is a part of this effort.
2. Instruction—The council encourages and supports the development of multidisciplinary courses and seminars and directed studies type programs. Although the council does not grant degrees, one of its missions is to investigate the possibility of instituting a 4-year environmental, problem-oriented undergraduate program.
3. Administration—The council assists students in arranging to earn credit for innovative, multidisciplinary study and assists faculty members by encouraging recognition and financial support for work done in new multidisciplinary courses and seminars and in environmental research.
4. Public Service—The council actively seeks to develop and fund public education lecture series and acts as a clearinghouse for requests from private organizations and from state and local government for consultant opinions on environmental questions.

More information about the council can be obtained from the chairperson.

## James Ford Bell Museum of Natural History

Harrison B. Tordoff, Director, 10 Church Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-2423

The museum maintains exhibits and public education programs on natural history and supports research in ecology, systematics, paleontology, and behavior of vertebrates. A natural history library that emphasizes collections in vertebrate zoology, behavior, and basic ecology is located in the museum.

The museum also houses the Field Biology Program, administered by the College of Biological Sciences. The Cedar Creek Natural History Area (located at Bethel, Minnesota) is a field resource administered by the University for the Minnesota Academy of Sciences; it is open to qualified scientists for research purposes. Information on the Lake Itasca Forestry and Biological Station summer session is available in a special University bulletin that is published each year.

## Department of Conferences

M. Alan Brown, Director, 131 Nolte Center for Continuing Education, 315 Pillsbury Drive S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-3151

The Department of Conferences, with support from the University of Minnesota academic faculty, assists groups in developing and presenting continuing education programs.

The department has a professional staff to assist interested parties in the planning, publicizing, administration, and evaluation of continuing education programs.

## Continuing Education in Public Policy

William Rogers, Director, 306 Wesbrook Hall, 77 Pleasant Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-3799

Continuing Education in Public Policy occasionally sponsors programs for the general public in the field of environment, urban problems, and planning. For further information, contact the director.

## Environmental Health Research and Training Center

Conrad Straub, Director, 1158 Mayo, 420 Delaware Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-8080

The Environmental Health Research and Training Center is concerned with examination and evaluation of environmental factors in relation to the health and well-being of humans. The center attempts to solve health-related problems through an interdisciplinary approach, using vital statistics data, epidemiological methodology, and other environmental information.

## Freshwater Biological Institute

J. M. Wood, Director, P.O. Box 100, County Roads 15 and 19, Navarre, Minnesota 55392; phone: (612) 471-8476

The Freshwater Biological Institute is a multidisciplinary unit, drawing faculty members from physics, chemistry, biochemistry, microbiology, limnology (plants, animals), and toxicology. The institute, administered by the College of Biological Sciences, has two major responsibilities: to conduct fundamental research on freshwater systems and to train graduate students drawn from the various disciplines. The institute's program is directed toward the study of geochemical processes, biological perturbations on geochemical processes, and environmental perturbations on both these geochemical processes and biological perturbations.

The institute also houses a library with publications and materials related to environmental problems in fresh water.

## Limnological Research Center

Herbert Wright, Director, 220 Pillsbury Hall, 310 Pillsbury Drive S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-4508

This center conducts research on the physical, chemical, biological, and geological aspects of lakes, especially those in Minnesota. Studies of lake history are made through analyses of microfossils and of the chemical and mineral components of sediments.

An evening seminar on current problems in limnological research is presented every winter quarter. Courses and degree programs in limnology are coordinated primarily through the Departments of Geology and Ecology and Behavioral Biology.

## Minnesota Environmental Sciences Foundation, Inc.

Edward Hessler, 5430 Glenwood Avenue, Golden Valley, Minnesota 55422; phone: (612) 544-8971

The Minnesota Environmental Sciences Foundation, Inc., offers a variety of in-service programs for teachers and the public throughout the metropolitan area. In addition, MESFI is active in curriculum development and program planning in the area of environmental education in its broadest sense, in site and park planning, and in research on cities as ecosystems.

The University of Minnesota does not accept for graduate credit courses and programs conducted by the foundation, but may allow undergraduate credit for them. Opportunities for experiential learning as a volunteer or to help fulfill academic requirements are offered. Students work with staff on projects at all levels of activity. Decisions to award undergraduate credit for MESFI activities are made on a case-by-case basis by the department involved.

## Minnesota Geological Survey

Matt S. Walton, Director, 1633 Eustis Street, St. Paul, Minnesota 55108; phone: (612) 373-3372

The Minnesota Geological Survey is engaged in a number of activities related to the environment and planning. These include developing a data base of waterwell logs and groundwater data for the state of Minnesota; compiling subsurface engineering geological maps for siting major structures and developing underground systems; studying the geological environment of Minnesota's peat resources in connection with the state's peat inventory program; participating in the regional environmental impact studies of the Copper-Nickel Task Force of Minnesota; and preparing for selected county atlases containing geological, hydrogeological, physiographic, resource, land suitability and other maps and data useful for environmental planning and management.

Approximately 30 students are employed by the survey as aides and research assistants. Whenever possible their work forms part of the research for a master's thesis or Ph.D. dissertation. Thus the Minnesota Geological Survey is a potential source of employment and research support in geologically related aspects of the environment and planning.

The Minnesota Geological Survey maintains a complete inventory of topographic, geologic, and soils atlas maps of the state, as well as publications on the state's geology and resources. For futher information, contact the director.

## Minnesota Public Interest Research Group (MPIRG)

Jonathan Motl, Executive Director, 3036 University Avenue S.E., Minneapolis, Minnesota 55414 (campus office in Coffman Union, Minneapolis campus); phone: (612) 376-7554 or 376-4798.

MPIRG is a nonprofit, nonpartisan organization representing Minnesota college students and working for constructive social change to benefit all Minnesotans. MPIRG activities focus on such issues as environmental protection, consumer protection, health care delivery, housing, human rights, occupational safety, and similar matters in the public interest.

MPIRG is funded by nearly 55,000 students on 15 Minnesota college and university campuses who pay a special fee of $1 per quarter or $3 per year for its support. The fee is refunded to students who do not wish to support the group.

MPIRG is directed by a board of elected student representatives from the participating institutions. The board holds open meetings at least once a month. All matters of organizational business— from hiring staff, to allocating a $170,000 annual budget, to selecting projects for the organization— are handled by the board. Any enrolled, fee-paying student may seek election to the board. Annual elections are held in the spring.

MPIRG employs a full-time staff of eleven people including three attorneys, four researchers, two organizers, and support staff.

MPRIG publishes a monthly newspaper, the Statewatch, and an internal newsletter, The Connection.

After careful investigation of selected problem areas, the MPIRG professional staff members and student participants work together in coordinated programs that involve publication of research findings and recommendations for public action, active representation before government administrative and regulatory agencies, law reform through legislative action, and, where necessary, legal action through the courts.

## Physical Plant Environment Engineering

Robert A. Reid, Principal Plant Engineer (Environmental), Physical Plant Maintenance and Operations, 200 Shops Building, 319 15th Avenue S.E., Minneapolis, Minnesota 55455; phone: (612) 373-0392

The University Physical Plant, which maintains facilities equivalent to those of a major Minnesota city, provides an opportunity for students to investigate practical environmental engineering problems and principles. All possible support is given to students who wish to explore the application of environmentally related innovations at the University. Credit may be earned for worthy projects of sufficient difficulty when arranged through appropriate departments.

## Center for Population Studies

Harry Foreman, Director, 12-186 Health Sciences Unit A, 420 Delaware Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-9656

The center coordinates graduate programs in family planning administration and in population studies.

## St. Anthony Falls Hydraulic Laboratory

Heinz Stefan, Associate Director, Mississippi River at 3rd Avenue S.E., Minneapolis, Minnesota 55414; phone: (612) 373-2782

The St. Anthony Falls Hydraulic Laboratory conducts research on the flow of water in streams, rivers, estuaries, lakes, and man-made pipes, channels, and reservoirs. Transport of sediment, heat, and dissolved substances as well as natural and artificial water storage, drainage, runoff, and other hydrological processes are part of the research program.

The laboratory provides academic and financial assistance to graduate and undergraduate students interested in water related programs.

## Office for Special Learning Opportunities (OSLO)

Field Learning Adviser, 201A Wesbrook Hall, 77 Pleasant Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-7550

See the College of Liberal Arts listing in the programs section of this guide.

## Underground Space Center

Raymond Sterling, Director, 11 Mines and Metallurgy, 221 Church Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 376-1200

The Underground Space Center is a division of the Mineral Resources Research Center and the Department of Civil and Mineral Engineering. The center was founded in November 1977 by the Minnesota Legislature in response to the growing interest in many aspects of underground space utilization.

The goals of the center are to: serve as a focal point for planning and coordination of underground space use; carry out research in areas affecting underground space use; provide an information and referral service for all aspects of underground space utilization; and serve as a focal point for international cooperation on research and information transfer.

One of the major activities of the center is conducting research and providing information on earth-sheltered housing, and the first report from the center was a book of guidelines for the design of such houses.

Further information and a number of publications (including the guidelines) are available from the center.

## Center for Urban and Regional Affairs (CURA)

Thomas M. Scott, Director, 311 Walter Library, 117 Pleasant Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone: (612) 373-7833

The regents established the Center for Urban and Regional Affairs to help make the University more responsive to the needs of the larger community and to increase the constructive interaction between faculty and students, on the one hand, and between the University and those dealing directly with major public problems, on the other hand.

The specific projects of the center are selected from a half-dozen broad problem areas reflecting major concerns in this region in this generation: housing, human relations, transportation, land use management, local government organization, and the diffusion of information about these topics. These problems cut across a wide and changing array of disciplines.

CURA's role is to help coordinate and stimulate projects in these problem areas. It works with the faculty and students of all academic units of the University. All CURA programs are pilot, experimental, or short term projects. The goal is to probe and evaluate, complete short-term projects, discard unsuccessful ones, and help build successful ones into the approporiate part of the academic structure. CURA does not have a permanent faculty or research staff and does not offer degrees. It confines itself to projects for which there is currently no other practical administrative home.

The center also publishes a newsletter, the CURA Reporter. Information about both the newsletter and the center may be obtained from the CURA office.

## Water Resources Research Center

John Waelti, Acting Director, 107 Hubbard Building, 2675 University Avenue, St. Paul, Minnesota 55114; phone: (612) 646-6309

The Water Resources Research Center was established in the Graduate School in 1964. The center has responsibility for stimulating water resources research at the

University of Minnesota and at state and private colleges through administration of funds associated with the Federal Water Resources Research Act of 1964; coordinating the research with programs of local, state, and federal agencies and private organizations throughout the state; and assisting in training additional scientists for work in the field of water resources through research. The following state and private colleges participate in the center's programs: St. Mary's College, St. Cloud State University, Gustavus Adolphus College, Bemidji State College, and Winona State University.

The center does not conduct research, nor does it have research facilities. The center supports water resources research activities of departments and schools and assists in expanding interdisciplinary research. It plans and arranges for divisions of the University of Minnesota and state universities and private colleges to conduct competent research of either a basic or practical nature in relation to the physical-biological-economic-social-political aspects of water resources.

One of the purposes of the center is to stimulate and review educational offerings that will prepare students for careers in the field of water resources. The center assists in recruiting students and in guiding them into appropriate programs of study. The center has been helpful to the University in developing many new courses in the area of water resources, a new graduate option in hydrology, and a graduate program in water resources.

The center publishes and distributes quarterly newsletters and information circulars to people throughout the state. Research projects generate many technical reports and theses. Upon request, the center distributes copies of its publications to people throughout the state and nation. To provide an opportunity for professional people and students working in the field of water resources to meet and exchange information, the center also sponsors interdisciplinary seminars and short courses.

# LIBRARIES

Twin Cities area libraries that have collections with an environmentally related emphasis are described below.

## University Libraries

The University's collection is so enormous, so diverse, and so dispersed that the best approach is through the main card catalog at Wilson Library. For information about the collection, call:

Catalog Information Desk— 373-9985
Reference Services Department— 373-3082

### O. Meredith Wilson Library

West Bank; Reference Division phone: 373-3082

Wilson Library, the main Twin Cities campus library, contains materials on the following subjects: economics, political science, geography, and sociology. It also contains most social sciences and humanities materials unless there is a separate subject library for a specific branch of one of these areas.

### St. Paul Campus Library

Buford Street; Reference Division phone: 373-0903

The St. Paul campus central library, and five subject libraries, provide materials and information services on ecology and the fields of agriculture, conservation, fisheries and wildlife, pesticides, food and nutrition, water, pollution abatement, and animal health. The card catalog indexes books and periodicals housed in the central library and in the following libraries: Andersen Horticultural; Biochemistry; Entomol-

ogy; Fisheries, and Wildlife; Forestry; Plant Pathology; and Veterinary Medicine. A library publication, Guide to Biographic Aids, summarizes the major resource materials pertinent to the different subject areas covered by the libraries' collections.

Several of the small University libraries maintain environmentally related collections either as part of their permanent collections or as reserve materials for courses or research groups. These include the following:

**Andersen Horticultural Library**

University of Minnesota Landscape Arboretum, Chaska, Minnesota 55318; phone: 443-2460

This library has a noncirculating collection of materials on horticulture, botany, landscape architecture, and natural history. It is used by Landscape Arboretum staff and visitors.

**Architecture Library**

160 Architecture; phone: 373-2203

The holdings of this library center on architecture, city and regional planning, and landscape architecture. These areas include such topics as housing, urban sociology, land resources and use, environmental psychology, energy conservation and the built environment, design methodology, urban design, and interior design.

**Bell Museum of Natural History Library**

305 Bell Museum of Natural History

A small library is located in the Bell Museum of Natural History, this collection emphasizes vertebrate zoology and basic ecology.

**Biochemistry Library**

406 Biological Sciences Center, St. Paul Campus; phone: 373-1582

In addition to the main subject areas— biochemistry, genetics, and cell biology— resources are available in other relevant areas: food herbicides, water pollution, chemicals, and insecticides.

**Biomedical Library**

Diehl Hall; phone: circulation— 373-2565, reference— 373-5584

Included in the library's holdings are books, periodicals, and conference proceedings, primarily of a technical nature, relating to ecology and the environment. The subject emphasis in these areas is on environmental health, animal ecology, and the physiological effects of various types of pollution. The library also has a number of specialized indexes and abstracts for material in these fields.

**Education Library**

Second floor, Walter Library; phone: 373-3841

Materials on environmental education are included in this collection, which covers all aspects of education and psychology.

**Engineering Library**

128 Lind Hall; phone: 373-2957

The library's collection includes the areas of water pollution and water resources, noise pollution, transportation, meteorology/climatology, power generation, and the TREE (The Renewable Energy Environment) collection, which consists of material on solar, wind, geothermal, and biomass energy forms.

**Entomology Library**

375 Hodson Hall; phone: 373-1741

The library's collection covers three major fields— entomology, fisheries, and wildlife.

**Forestry Library**

203 Green Hall; phone: 373-1407

The Forestry Library collection includes the fields of forestry, forest products, and forest resources as well as the related areas of outdoor recreation, hydrology, climatology, aerial photography and remote sensing, and range management.

**Geology Library**

204 Pillsbury Hall; phone: 373-4052

The collection contains about 30,000 books and serials on all fields of geology. Among subjects included are environmental geology, geochemistry, groundwater, lakes, mineral analysis, mineral resources, rivers, water pollution, and water quality. The library also has a map collection that contains over 70,000 topographic and geologic maps.

**Government Publications**

409 Wilson Library; phone: 373-7813

The collection includes publications from government departments and agencies at all levels: national, state, and local. Because government is involved with environmental problems and planning, this in many respects is the only collection on campus containing some material on every aspect of environment studies. Among federal agencies represented are: the Council on Environmental Quality, Environmental Protection Agency, and Energy Research and Development Administration. Among state agencies included are: the Pollution Control Agency, State Planning Agency, Energy Agency, and Environmental Quality Board.

**Law Library**

150 Law; phone: 376-2359

Environmental law materials form part of this collection.

**Mines, Metallurgy, and Chemical Engineering Library**

132 Chemical Engineering; phone: 373-2313

The library contains some books and periodicals relating to industrial pollution control.

**Plant Pathology Library**

202 Stakman Hall; phone: 373-1669

The Plant Pathology Library contains approximately 5,500 books, 5,400 government documents, and 125 serials dealing with plant diseases and their control, mycology, and nematology and supporting material in virology. A librarian is on duty in the afternoon only. Since it is open mornings without a librarian, the library depends on the integrity of the people who use its services.

**Public Administration Library**

365 Blegen Hall; phone: 373-2892

The Public Administration Library maintains a collection of 42,000 monographs, documents, research reports, and other publications emphasizing the administrative and public policy aspects of most federal, state, regional, and local activities within the wide definition of public administration. Included are the areas of planning and urban affairs, human services, housing and redevelopment, finance and taxation, and intergovernmental relations, as well as materials on quantitative methods for policy analysis and evaluation. Some materials related to environmental policy are also available. Additional information sources include bibliographies, periodicals, newsletters, periodical indexes, and a clipping file of newspaper articles in subject areas covered by the collection. This collection is only partially covered in the main card catalog in Wilson Library.

**Straub Memorial Library,**
**St. Anthony Falls Hydraulic Laboratory**

Mississippi River at Third Avenue S.E.; phone: 373-2782

The library has a collection of books and more than 18,000 monographs, U.S. government publications, and other reports dealing with water resources and the environment.

**The Renewable Energy Environment Collection (TREE)**

128 Lind Hall; phone: 373-2957

The TREE Collection, which contains information on solid waste management, solar energy, thermal energy storage, and biomass utilization, is housed in the Engineering Library, 128 Lind Hall. It is accessible for browsing and kept current by contributions from CURA, University staff, and public contributors.

**Urban Transportation Literature Collection**

150 Experimental Engineering; phone: 373-2509

Specific topic areas of this collection include urban transportation as it relates to air pollution, noise, natural resources, open space, energy consumption, exhaust emissions, and recreation.

## Environmental Conservation Library (ECOL)

Minneapolis Public Library, 300 Nicollet Mall, Minneapolis, Minnesota 55401; phone: 372-6609

ECOL, a special collection within the Minneapolis Public Library, brings together materials from various subject fields that relate to the physical environment and human impact on it. ECOL has books, periodicals, newsletters, pamphlets, bibliographies, posters, and government documents relating to such topics as air and water pollution, solid waste, wildlife, conservation of natural resources, land use planning, environmental law, energy resources, and environmental education. ECOL was designated by the Minnesota Legislature as a state center for environmental information and receives publications of many state agencies, including environmental impact statements. ECOL serves as the local public document room for U.S. Nuclear Regulatory Commission materials relating to nuclear power plants in Minnesota. A catalog of the collection has been printed, and copies are available in libraries on all campuses of the University.

## Mid-American Solar Energy Complex Library

1256 Trapp Road, Eagan, Minnesota 55121; phone: 452-5300

MASEC promotes solar energy commercialization, application, use, and conservation integral to solar application. The library's collection includes books, documents, reports, journals, patents, legislative bills, directories, and reference material. Services will be provided to 12 mid-American states. The center is coordinated with the National Solar Energy Research Institute in Golden, Colorado, and three other regional centers, all funded by the U.S. Department of Energy. The center library is presently under development prior to receiving contract.

## Minnesota Department of Health Library

717 Delaware Street S.E., Minneapolis, Minnesota 55440; phone: 296-5240

This collection has been developed with the needs of public health professionals in mind. Consequently, it is essentially a specialized library with technical, as op-

posed to popular, literature. It is a reference collection only and extends no loan privileges. The library subscribes to some 270 periodicals, and the library staff prepares weekly a mimeographed subject index of new articles of public health significance.

## Minnesota Energy Agency Library

980 American Center Building, 160 East Kellogg Boulevard, St. Paul, Minnesota 55101; phone: (612) 296-8902

This energy research library has a noncirculating collection, although some items may be borrowed through the MINITEX system. The library receives 95 percent of the NTIS energy reports listed in Government Reports Announcements abstracts and in microfiche automatically and will loan these. The collection contains United States and Minnesota statistics of energy use, Department of Energy reports, and approximately 200 periodicals. There is strong emphasis on energy conservation reports as well as energy forms. There is an energy product file on energy saving devices, and solar, wind, and wood burning equipment. The library has environmental information on coal development, electric power, nuclear power, solar, etc.

## Minnesota Pollution Control Agency (MPCA)

1935 W. County Road B-2, Roseville, Minnesota; phone: 296-7719

This collection has been developed with the needs of professional pollution control engineers in mind. Therefore, it is essentially a technical library with few subprofessional materials. The library extends both reference and loan services.

## Population Resource Center

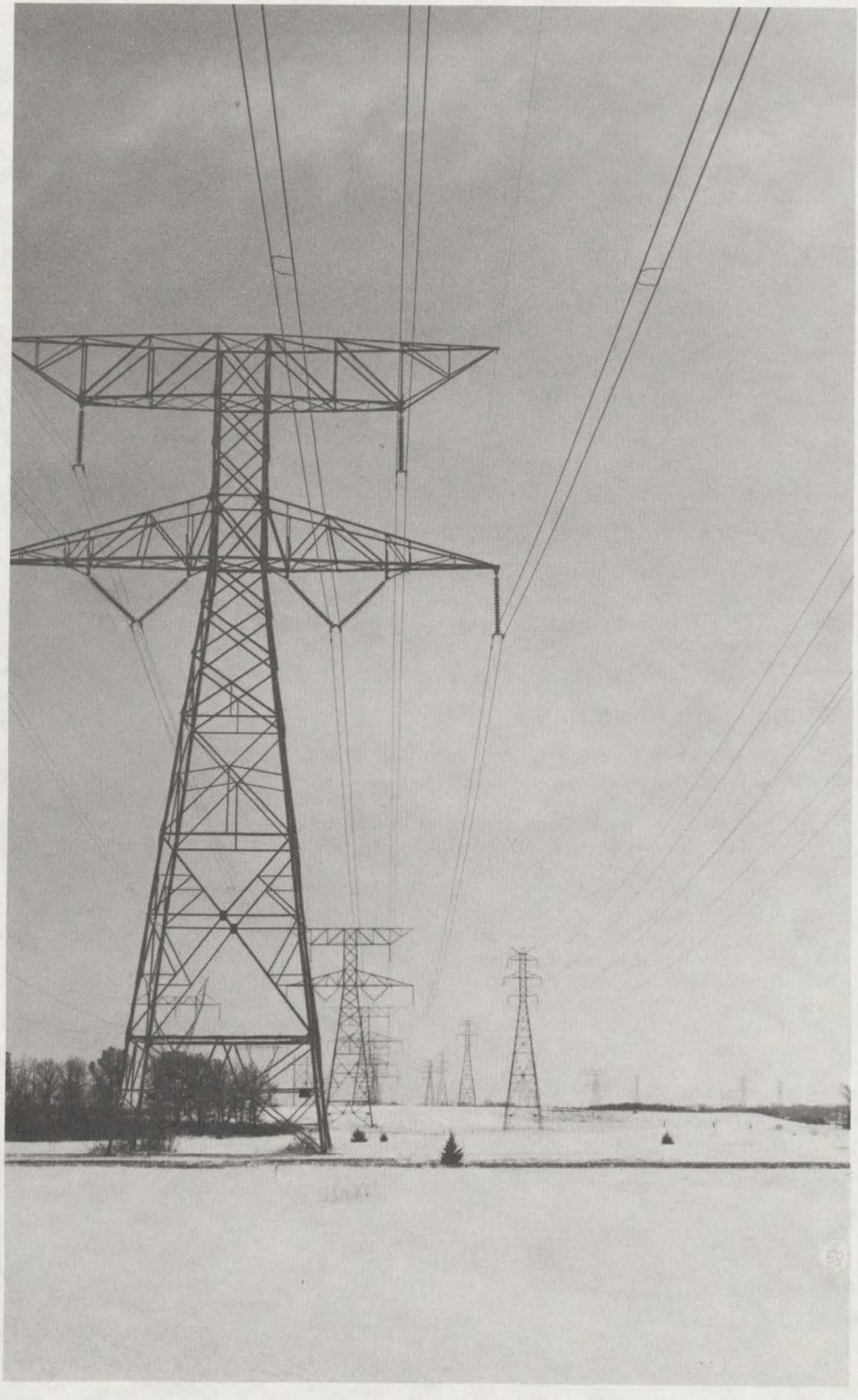
1965 Ford Parkway, St. Paul, Minnesota 55116; phone: 698-2401

The Population Resource Center is a multimedia library of materials on population growth, human sexuality, sociology of family planning, abortion, contraceptive technology, history of the birth control movement, and related subjects.

Originally funded by the Bush Foundation and now part of Planned Parenthood of Minnesota's Education Department, the center makes the growing body of literature on these subjects available and useful to students, the general public, teachers, and health professionals. The collection includes more than 1,600 books, 60 journal subscriptions, many reprints and articles, more than 100 types of pamphlets for public distribution and sale, and approximately 60 films and filmstrips.

An extensive research ang service is maintained so that persons outside the Twin Cities have access to resource center materials. A quarterly publication, *What's New...in the Population Resource Center,* that lists current materials and recent acquisitions is mailed to 1,200 people throughout the state. Annotated bibliographies on abortion, birth control, methods of family planning, population, population education, human sexuality, preadolescent and adolescent sexuality, research in contraception, and venereal disease are also available.

A card catalogue helps users find materials. All journal articles pertinent to the collection are catalogued in a guidebook for quick and easy reference. Books may be borrowed at no charge.



# III. UNIVERSITY OF MINNESOTA, DULUTH

Duluth, Minnesota 55812

CONTACTS: Bill Fleischman, Department of Sociology-Anthropology, (218) 726-7208
John Green, Department of Geology, (218) 726-7208
John Kotar, Department of Biology, (218) 726-8123

The *UMD Bulletin* contains details of the various majors and other programs that deal with environmental topics. A detailed subject index of environmentally related courses follows, and individual department programs and courses conclude this section.

## SUBJECT INDEX

CONSUMER PROTECTION

Econ 5003. Consumer Economics

ECOLOGY

See Department of Biology course listing

ECONOMICS/COST-BENEFIT

Econ 1002. Introduction to Economics
Geol 5630. Economic Aspects of Geology

EDUCATION

5326. Environmental Education for Teachers
5235. Energy Education for Teachers

ENERGY

Geol 1100. Topics: Limits of Earth Resources; Man and Resources
IS 1101. Energy: Its Sources, Uses, and Future
IS 3100. Man's Environment and Future
Phys 1020. Energy Resources: Sources, Use, and Conservation
Soc 1250. Social Implications of the Energy Crisis

ENVIRONMENTAL IMPLICATIONS

Geography

Geog 1201. Man and His Habitat
Geog 1403. Physical Geography

Technology

Chem 3106. Chemistry in Modern Life
Geol 1100. Topics in Geology
Geol 3150. Environmental Geology

ENVIRONMENTAL SURVEY COURSES

Biol 1102. Biology and Man
EdSe 3234. Science, Technology, and Society
Geog 1305. Environmental Conservation
IS 3100. Man's Environment and Future
Phys 3050. Environmental Studies

FOOD/NUTRITION

HE 1470. Survey of Human Nutrition

GEOLOGY

Geol 1100. Topics in Geology
Geol 1110. Introductory Geology

Geol 3131. Oceanography
Geol 3150. Environmental Geology
Geol 3200. Geomorphology
Geol 3310-3311-3312. Earth Materials I-II-III
Geol 3600. Economic Geology
Geol 5200. Hydrogeology
Geol 5211. Glacial and Quaternary Geology

LIMNOLOGY

Biol 5773. Limnology

METEOROLOGY/CLIMATOLOGY

Geog 3412. Weather Elements
Geog 3422. Climatology

PUBLIC POLICY

Pol 3020. State Government
Pol 3060. National Policy Issues
Pol 3080. Government and Conservation
Pol 3220. Introduction to Public Administration

RESOURCES

Geog 1305. Environmental Conservation
Geol 1100. Topics in Geology
Geol 3600. Economic Geology
Geol 5630. Economic Aspects of Geology
Pol 3080. Government and Conservation

WATER

Geol 5200. Hydrogeology

# COURSE LISTINGS

## Anthropology (Anth)

**5630. HUMAN ECOLOGY.** (4cr; prereq 1604 and #)
An in-depth study of some of the methods and concepts concerning the interrelations of human populations and their environments in diverse natural, cultural, historical, and evolutionary settings.

## Biology (Biol)

**1102. BIOLOGY AND MAN.** (5 cr; 4 hrs lect, 2 hrs lab)
Principles of modern biology; origin and nature of life, genetics, eugenics, evolution, population dynamics, ecology, pollution, pesticides, radiation, drugs, and other problems of humans in their environment.

**3773. GENERAL ECOLOGY.** (3 cr; prereq 10 cr in general biology; may be taken without lab 3774)
Introduction to the principles and theory of environmental biology; functional approach to ecosystems.

**3774. GENERAL ECOLOGY LABORATORY.** (2 cr; prereq concurrent regis or prior cr in 3773; 3 hrs lab)
Experience in methods of measuring environmental factors, interpreting data.

**5523. NATURAL HISTORY OF INVERTEBRATES.** (4 cr; prereq 10 cr general biology; 2 hrs lect, 4 hrs lab and field) Krogstad
Collection, identification, life histories and ecological relationships of local invertebrates; emphasis on aquatic species.

**5524. NATURAL HISTORY OF VERTEBRATES.** (4 cr; prereq 10 cr general biology or #; 2 hrs lect, 4 hrs lab) Hofslund
The way of life of vertebrate animals, including the study of their origins, principles of taxonomy, population dynamics, and adaptations to living within their environment.

**5671. ECOLOGY OF AQUATIC INVERTEBRATES.** (4 cr; prereq 5561 or 5523; 2 hrs lect, 4 hrs lab and field; offered 1978-79 and alt yrs) Krogstad
Studies of planktonic and benthic invertebrates in different environments; methods of sampling, determination of population density, detailed taxonomic studies and the preparation of scientific reports appropriate for an environmental impact statement.

**5773. LIMNOLOGY.** (4 cr; prereq 3773, 3774, organic chemistry or #; 2 hrs lect, 4 hrs lab) Hargis
Biological, chemical and physical aspects of lakes and streams. Extensive laboratory and field analysis of the ecological relationships between aquatic organisms and their environment.

**5775. PLANT ECOLOGY.** (5 cr; prereq 3773, 5461, and Math 1110; 3 hrs lect, 4 hrs lab; offered 1978-79 and alt yrs) Kotar
Plant-environment relationships; local and North American communities succession; abiotic factors and their measurement.

**5871. WATER POLLUTION BIOLOGY.** (3 cr; prereq 5773 or #; 2 hrs lect, and 2 hrs lab) Hargis
A consideration of the responses of aquatic organisms, communities, and ecosystems to pollutants and human use.

# Chemistry (Chem)

**3106. CHEMISTRY IN MODERN LIFE.** (4 cr; will not satisfy requirements for a major or minor in chemistry; primarily for majors in the humanities and social sciences)
Consideration of chemistry from standpoint of its effect and influence on contemporary problems. No science background is assumed.

# Economics (Econ)

**1002. INTRODUCTION TO ECONOMICS.** (4 cr [cr not allowed toward economics major or minor]; designed specifically for liberal education purposes)
General description of the economy of the United States and an analysis of contemporary economic problems. Will introduce the student to the major economic issues and problems of the day and provide a simple framework, used by the economist, for analysis of these issues and problems.

**5003. CONSUMER ECONOMICS.** (4 cr; prereq 1005 or #)
Application of economic principles to major decisions of consumers. Concept of alternative choice. Opportunity cost. How to use income most effectively; use of credit; saving; insurance principles; analysis of advertising as it affects the consumer; sources of consumer information; product testing agencies; analysis of contracts common to consumers; government efforts to protect consumers.

# Geography (Geog)

**1201. MAN AND HIS HABITAT.** (4 cr)
The geography of human groups in diverse physical settings. Description and analysis of favorable and unfavorable habitats for human occupation including geographical analysis of selected countries. Emphasis on our use and misuse of the environment.

**1305. ENVIRONMENTAL CONSERVATION.** (4 cr)
Natural resources of the earth and our cultural modification of them. Emphasis on planning for and control of our use of the environment.

**1403. PHYSICAL GEOGRAPHY.** (4 cr)
Earth-sun relations, maps and globes, and major factors of the natural environment including water resources, landforms, weather and climate, natural vegetation, and soils.

**1413. PHYSICAL GEOGRAPHY WITH LABORATORY.** (5 cr)
See 1403.

**3324. GEOGRAPHY OF INDUSTRIAL LOCATION.** (4 cr; prereq 1303, 1312)
Locational analysis of industry and industrial patterns. Introduction to spatial theory and model building with emphasis on integrating real world phenomena with theoretical, industrial location factors.

**3331. URBAN GEOGRAPHY.** (3 cr; prereq 1303 and 1403)
Function and distribution of cities in present-day world, including analysis of their development. Emphasis on American cities, their internal structure, form, and planning processes.

**3412. WEATHER ELEMENTS.** (4 cr; prereq 1403 or #)
Topics include atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones, and anticyclones; general weather patterns.

**3422. CLIMATOLOGY.** (2 cr; prereq 1403 and 3412 or #)
Various climatic classifications; analysis of climatic regions of continents based on the Trewartha (modified Koppen) system. Individual student projects.

# Geology (Geol)

**1100. TOPICS IN GEOLOGY.**
Specific topics of general interest selected for a greater in-depth study at a beginning level than can be accomplished in Geol 1110 (Introductory Geology). Current topics include: the great ice age, continental drift, history of life, limits of earth resources, national parks, geology and religion, bedrock geology of Minnesota.

**1110. INTRODUCTORY GEOLOGY.** (5 cr; 4 lect and 2 lab hrs per wk)
A comprehensive survey of the planet earth including its composition, structure and dynamics; an understanding of both internal and surface processes is developed and related to theories of sea-floor and continental movement, the whole serving as a framework for a summary of geological history and the development of life.

**3131. OCEANOGRAPHY.** (4 cr, §3130; 3 hrs lect)
The physicochemical nature of marine waters; origin and history of oceans and basins; processes, currents, tides; ocean and continental relations, sedimentation in oceans, development of oceans, development of ocean floor topography; nature of marine organisms, productivity, trophic levels, ecosystems, ocean resources. Term paper.

**3150. ENVIRONMENTAL GEOLOGY.** (4 cr; prereq 1110 or #) Green
The interactions between human beings and their physical environment; the restraints and influences on human activities imposed by geologic processes, history, and the constitution of the earth. Engineering-geological strategies for dealing with some of these problems. Field investigation of an environmentally relevant local geologic problem.

**3200. GEOMORPHOLOGY.** (4 cr; prereq 1110; 3 hrs lect, 2 hrs lab) Matsch
Geologic processes of the earth's surface environment that produce the major elements of the landscape. Aerial photographs and topographic maps as tools for interpreting the origin and geological history of landscapes. Field trips.

**3310-3311-3312. EARTH MATERIALS I-II-III.** (5/4/4 cr; prereq 1110 and 1 yr high school chemistry or 1 qtr college chemistry; 3 hrs lect and 4 hrs lab for 3310..2 hrs lect and 4 hrs lab each for 3311 and 3312) Grant, Green, Ojakangas
The study of the common and important rocks and minerals including their origin, composition, classification, identification, and use. 3310: includes introduction to crystallography, crystal chemistry, and the use of the polarizing microscope. Field trips.

**3600. ECONOMIC GEOLOGY.** (4 cr; prereq 3312; 3 hrs lect and 2 hrs lab) Marsden
The geologic description, geographic distribution, and origin of economic mineral materials including petroleum, coal, and groundwater.

**5200. HYDROGEOLOGY. (3 cr; prereq 3200 or #)** Matsch
Quantitative analysis of the hydrologic cycle, including precipitation, evaporation, and surface runoff measurements. Theory of groundwater flow. Geology of underground water reservoirs. Introduction to water resource management.

**5211. GLACIAL AND QUATERNARY GEOLOGY.** (4 cr, §5210; prereq 1110 or #; 3 hrs lect and 2 hrs field lab) Matsch
Physics of glaciers (glaciology), including their erosional and depositional activities. Survey of geological and biological responses to the changing environment resulting from climatic fluctuations during the last 3 million years of earth history. Field studies on the glacial deposits of Minnesota.

**5630. ECONOMIC ASPECTS OF GEOLOGY.** (2 cr; prereq 3600 or #) Marsden
Political, economic, and environmental factors influencing the mineral industries. Term paper.

# Home Economics (HE)

**1470. SURVEY OF HUMAN NUTRITION.** (3 cr, §1330)
A survey of the nutrients with emphasis on the foundation of a balanced diet required for physical well-being.

**1560. INTRODUCTION TO HOUSING.** (4 cr, §1810; prereq 1500 or #; 2 lect and 4 lab hrs per wk)
The physical, social, economic, and environmental aspects of choosing and maintaining a home.

**3575. COMMUNITY HOUSING.** (3 cr, §3510; prereq Soc 1100 or Soc 1400; 2 lect and 2 lab hrs per wk)
Historic, economic, sociological, and psychological aspects of housing; government involvement in housing.

# Interdisciplinary Studies (IS)

**1101. ENERGY: ITS SOURCES, USES, AND FUTURE.** (3 cr)
Survey of energy sources, their current use and misuse, their role in national and international economies and politics, and the future outlook of energy-dependent societies.

**3100. MAN'S ENVIRONMENT AND HIS FUTURE.** (3 cr; 2 hrs lect, 1 hr discussion-rec)
The relationship of human beings to the animate and inanimate world in and on which they live, the consequences to the environment of their actions, the implications of various philosophical and economic principles for their future existence, and some of the possible choices they have for long-term survival in a world of finite resources. Several lectures; term paper; discussion groups.

# Physics (Phys)

**1020. ENERGY RESOURCES: SOURCES, USE, AND CONSERVATION.** (4 cr) Oakland
A survey of the nature and scope of the energy crisis with emphasis on the physical principles and engineering problems. Topics will include: available resources, production and conversion methods, distribution, use and conservation; evaluation of the future potential of conventional sources plus alternative sources such as nuclear fusion, wind, geothermal, wood, and biomass; conservation potential and current practices from the individual to the national scale.

**3050. ENVIRONMENTAL STUDIES.** (3 cr; will not satisfy requirements for majors or minors in physics; prereq 1001 or #; 3 hrs lect)
Studies of the environment through application of elementary laws of physics. Topics treated: heat balance and transport for earth's surface; radioactivity, elements of remote sensing in biology, geology, and physics; selected topics on natural phenomena. A portion of the course will consist of guest lectures by persons engaged in research on environmental problems.

# Political Science (Pol)

**3020. STATE GOVERNMENT.** (4 cr; prereq 1011)
The states in the American federal system; governmental institutions and processes; intergovernmental relations. Special reference to Minnesota.

**3060. NATIONAL POLICY ISSUES.** (4 cr; prereq 1010 or #)
Critical issues of contemporary national government; emphasis on finance, foreign and military policy, and environmental policy decisions.

**3080. GOVERNMENT AND CONSERVATION.** (4 cr; prereq 1011 or #)
American natural resource problems with special attention to conservation activities at the national, state, and local levels; development of conservation agencies in Minnesota.

**3220. INTRODUCTION TO PUBLIC ADMINISTRATION.** (5 cr, §3210; prereq 1011)
Introduction to the internal operations of bureaucratic organizations and the role of the latter in governmental policymaking. Capability of modern bureaucracy in meeting its own goal of technical efficiency; impact of bureaucratic forms of organization on a democratic society.

# Secondary Education (EdSe)

**3234. SCIENCE, TECHNOLOGY, AND SOCIETY.** (3 cr)
A nontechnical study of the historical and cultural impact of natural science and technology on the earth and its inhabitants. This course is open to any interested students.

**5235. ENERGY EDUCATION FOR TEACHERS.** (1-3 cr)
Combines contemporary information concerning energy and energy related problems with resource persons and experiences in the field to prepare pre-service and in-service teachers for implementation of energy related learning experiences into the school curriculum, grades K-12, all subjects. While intended for teachers, the course is open to any interested student.

**5236. ENVIRONMENTAL EDUCATION FOR TEACHERS.** (1-4 cr [may be repeated for max 4 cr]; prereq #)
Combines environmental study with field experiences to prepare pre-service and in-service teachers for implementation of environmental learning experiences in the school curriculum, grades K-12, all subjects. While intended for teachers, the course is open to any interested student.

# Sociology-Anthropology (Soc)

**1100. PROBLEMS OF AMERICAN SOCIETY.** (5 cr [cr not allowed toward sociology-anthropology major or minor], §1101, §1105)
Applications of the sociological perspective to social problems within the United States.

**1250. SOCIAL IMPLICATIONS OF THE ENERGY CRISIS.** (2 cr)
Special topics seminar.

**3190. CURRENT SOCIAL ISSUES.** (4 cr; prereq 1100 or #; nonmajors only)
Applications of sociological theory and research to current topics; analysis of community life, social movements, and social conditions.

**3900. SOCIAL ISSUES AND SOCIAL CHANGE.** (4 cr, §3190; prereq 3420 or #)
Analysis of the forces of social change and social issues as they affect social life. Emphasis on the use of social theory and research in comprehending the dynamics of issues and changes.

**5170. URBAN SOCIOLOGY.** (4 cr, §5121; prereq #)
Cities; urban ecology; urban institutions; and urban way of life.

## LAKE SUPERIOR BASIN STUDIES CENTER

Thomas Wood, Director, 413 Administration Building, University of Minnesota, Duluth, Minnesota 55812

The Lake Superior Basin Studies Center is an interdisciplinary team of scientists, educators, and planners involved in research and education projects related to all aspects of life in Lake Superior and its surrounding basin area.

UMD students interested in the local environment can make use of the center in several ways. The center maintains a reference library of works concentrating on technical research relevant to the area. The library presently contains more than 2,500 volumes covering such areas as limnology, forestry, land-use planning and practices, and hydrology. The Lake Superior Reference Library is located in 108 Washburn Hall.

With the approval of their adviser, UMD undergraduates may work as interns at the center for credit. This program offers interested undergraduates "hands-on" experience that can be extremely rewarding.

The center also sponsors a variety of public information programs during the academic year to examine critical issues facing this area. The programs are advertised in *The Statesman* and admission is always free.

Students who would like more information about the center are invited to stop at the main office, 413 Administration Building, or call 726-8542.

# IV. UNIVERSITY OF MINNESOTA, MORRIS

Morris, Minnesota 56268

CONTACTS: Joseph J. Latterell, Division of Science and Mathematics, Science Building, (612) 589-2211

James Olson, Acting Chairman, Division of Science and Mathematics, Science Building, (612) 589-1644

The Division of Science and Mathematics offers a bachelor of arts degree with majors and minors in biology, chemistry, geology, mathematics, and physics, as well as in life science education, physical science education, and earth science education. There is also an individual curriculum option that allows students to design their own major program. See the *UMM Bulletin* for more information about these programs as well as additional course listings.

Note also that in addition to its regular offerings each discipline has a series of directed studies courses in which a student and faculty member may cooperate to design a course experience to meet special needs of the student's program.

Several active research programs are also being pursued in environment-related areas, under the supervision of one or more faculty members specializing in those areas. These programs offer opportunities to the student for either directed studies or employment; contact department heads for information regarding those programs. The areas include: the Eagle Lake Program, an interdisciplinary study of the lake ecosystem, with opportunities for students in biology, chemistry, geology, and mathematics; the Prairie Project, a study of the ecology of local virgin prairies, for biology students; and the Atmospheric Program, which includes atmospheric electricity and air pollution photochemistry, for students in physics and chemistry. In addition, UMM geologists maintain a seismographic center as part of a statewide earth tremor monitoring system.

## Biology (Biol)

**3100f. BIOLOGY AND MAN'S FUTURE.** (5 cr; cannot be used to satisfy GER in Natural Sciences and Mathematics; not offered 1978-79)
Biological factors influencing the future of human life; e.g., population size and structure, applied genetics, biochemical control of behavior, biological basis of social organization, food supply, environmental change, biological aspects of ethics and morals, space biology.

**3110w. BIOETHICS.** (5 cr; prereq jr or sr status and one science course; 4 hrs lect and discussion; not offered 1977-78)
Ethical problems related to the discovery, dissemination, and applications to human life of biological information. The "nature" of human life, the concept of purpose, the use of humans in research, birth control, death control, medical priorities, biochemical control of behavior, transplants, genetic engineering, and other manipulations of the genetic composition of human populations.

**3850s. ECOLOGY.** (5 cr; prereq 1111; 3 hrs lect, 6 hrs lab, and field study; lab fee required)
Relationship of organisms to each other and to their nonliving environment; biogeography with emphasis on North America.

**3860f,w,s. STUDIES IN FIELD BIOLOGY.** (0-1 cr; prereq #; students may not apply more than 6 cr toward their requirements for the major or minor)
Biological field studies of selected habitats.

## Geology (Geol)

**1100f. THE EARTH I— OUR PHYSICAL ENVIRONMENT.** (5 cr; 3 hrs lect, 4 hrs lab; lab fee required)
Introduction to the materials that make up the earth; the earth's structure, surface features, and geologic processes involved in their development; people as geological agents. Laboratory work includes the study of rocks and minerals and of geologically interesting features on maps and aerial photographs.

**1110w. THE EARTH II— A HISTORICAL PERSPECTIVE.** (5 cr; prereq 1100; 3 hrs lect, 4 hrs lab; lab fee required)
Significant events in the earth's history and the development of life as interpreted from the rock and fossil record in association with the theories of sea floor spreading and drifting continents; emphasis on the geologic history of North America. Laboratory experience devoted largely to methods of interpreting earth's history and fossil classification and identification.

**1120s. EARTH SCIENCE.** (5 cr; 3 hrs lect, 4 hrs lab; lab fee required)
An introduction to astronomy and meteorology. Topics in astronomy include motions of planets and stellar bodies, size and distance measurements, properties of solar and stellar bodies, interstellar matter, galaxies, and the tools of the astronomer. Topics in meteorology include atmospheric composition, air masses, circulation patterns, atmospheric disturbances, meteorological instruments, weather forecasting, and some effects of human activities.

**3200w. EARTH MATERIALS I— THE MINERALS.** (5 cr; prereq 1100, Chem 1301 or 1501, or #, 3 hrs lect, 4 hrs lab; lab fee required)
Introduction to mineralogy and crystallography; classification, identification, physical and chemical properties; origin and natural occurrence of major mineral groups. Laboratory study of crystal systems by use of models; optical aspects and physical and chemical testing.

**3210s. EARTH MATERIALS II— THE ROCKS.** (5 cr; prereq 3200; 6 hrs lect-lab and field trips; lab fee required)
Classification, composition, genesis, and natural occurrence of igneous, metamorphic and sedimentary rocks; laboratory study and identification of rocks by various macroscopic, microscopic (including petrographic), and chemical means.

**3400s. EARTH PROCESSES I— LANDFORM DEVELOPMENT.** (5 cr; prereq 1100; 3 hrs lect, 4 hrs lab and field trips; lab fee required)
(Same as Geog 3400) Introduction to geomorphology and environmental geology; processes at work at the earth's surface; the resulting landforms and products; interrelationships between human activities and geomorphic processes; laboratory study of aerial photographs, topographic and surficial geology; evaluation of local geomorphic processes.

**3410f. EARTH PROCESSES II— STRUCTURAL.** (5 cr; prereq 3210 or #; 6 hrs lect-lab and field trips; lab fee required)
Theory of rock deformation; description and classification of structures of the earth's crust; application of geometric, graphic, and map interpretation techniques to solution of structural problems; field mapping problem.

**3450f. STRATIGRAPHY AND SEDIMENTATION.** (5 cr; prereq 1110, 3210, or #; 6 hrs lect-lab and field trips; lab fee required)
An introduction to the principles of stratigraphy and processes of sedimentation. Emphasis on correlation problems, use and construction of thickness and facies maps and cross sections; origin, transportation, and deposition of sediments; recognition and interpretation of ancient sedimentary environments.

**3460w. INTRODUCTION TO INVERTEBRATE PALEONTOLOGY.** (5 cr; prereq 1110 or #; 3 hrs lect, 4 hrs lab; lab fee required)
*The morphology and evolutionary record of the major invertebrate groups characterized by significant fossil representation. Principles of evolution, paleoecology, and paleoenvironmental interpretations of fossil assemblages.*

**3550s. GEOLOGICAL FIELD METHODS.** (3 cr; prereq 3410; field trips)
Introduction to geologic sampling, mapping, and note-taking; study of topographic and geologic maps and aerial photographs; preparation of geologic maps and reports.

**3600su. FIELD GEOLOGY.** (9 cr; prereq 3550; 6 wks in field)
Field training in geologic mapping, measuring sections, and interpreting geologic history using the alidade, Brunton compass, topographic maps, and aerial photos. A comprehensive report complete with geologic map, columnar sections, and cross sections is required.

**3900w. GEOLOGY SEMINAR.** (1-3 cr; 1 cr required for geology major; prereq #)
The seminar approach to the study of any of a number of selected topics of geologic interest.

**3950f, 3951w, 3952s. DIRECTED STUDIES.** (1-5 cr per qtr; prereq #)

# Physical Science (PSci)

**1100-1101. CONCEPTS AND METHODOLOGY IN PHYSICAL SCIENCE.** (5 cr per qtr; 3 lect, 1 rec, and 2 lab hrs per wk; lab fee required)
Topics selected from everyday experiences in the physical world to foster an understanding of the development and formulation of the laws of physical science. Utilization of these laws and principles by individuals and society as a whole. Concepts of observation, measurement, motion, energy, etc., from both the pure and the applied scientific points of view.

# V. TECHNICAL COLLEGE, CROOKSTON

Crookston, Minnesota 56716

CONTACT: Philip Buckley, Division of Agriculture, (218) 281-6510

The associate of applied science curricula at the University of Minnesota Technical College, Crookston, are designed to emphasize preparation for entrance into semiprofessional or midmanagement occupations. Associate of applied science curricula are available in the following environmentally related areas: natural resources conservation; park and recreational area management; biological laboratory technology; and soil, water, and civil engineering technology. For further details, consult the Technical College, Crookston, Bulletin.

The Red River Valley Natural History Area, a tract of approximately 85 acres located in the flat lake bed of glacial Lake Agassiz in northwestern Minnesota, was established by the University of Minnesota as a living museum and teaching laboratory. The area contains an interesting assortment of habitats including prairie, aspen forest, cottonwood forest, willow swamp, and cattail marsh. Each of these habitat types supports a particular group of plant and animal species, some of which are becoming rare because of intensive land use. Nature trails wind throughout the different habitats allowing educational groups to experience the diverse plant and animal life present and to view ecological research demonstrations.

## Agricultural Aviation (AgAv)

**1601f,w,s. SURVIVAL SKILLS.** (1 cr; prereq aviation or natural resources major)
Basic physiological and psychological aspects of survival. Topics will include the psychology of survival, hypothermia, frostbite and freezing, survival first aid, shelter building for various climates, water requirements, water collection and purification, food collection techniques, travel, signaling, and related topics.

## Agronomy (Agro)

**1463f. RANGE MANAGEMENT.** (3 cr; two lect hrs and one 2-hr lab)
Definition and kinds of rangeland, plant growth and response to management techniques, range evaluation and utilization, management planning, grazing systems, multiple use and the environment.

## Biology (Biol)

**1104. GENERAL BIOLOGY.** (4 cr; prereq 1013 or high school biology)
Introduction to the major biological concepts common to both plants and animals.

**1204. INTRODUCTION TO LIMNOLOGY.** (4 cr; prereq 1104, Chem 1104)
Ecology of lakes, streams, and ponds emphasizing factors that affect biological productivity. Laboratory and in-field study stressed. Modern techniques for water sampling and analysis will be employed to determine the identity and quantity of biological and chemical materials present.

**1214. GENERAL BOTANY.** (4 cr; prereq 1104)
Fundamental principles of plant biology with emphasis on morphology, physiology, and classification of plants. Lecture and laboratory.

**1224. GENERAL ZOOLOGY.** (4 cr; prereq 1104)
Survey of the major animal phyla and principles of animal biology. Anatomy and physiology of mammals emphasized. Lecture and laboratory.

**1304. INTRODUCTION TO PLANT PHYSIOLOGY.** (4 cr; prereq 1104, 1214)
General metabolic processes; photosynthesis, respiration, nutrition, absorption, germination, flowering, and growth, with emphasis on influences of environmental and hormonal control.

**1565. MICROBIOLOGY.** (5 cr; prereq 1104)
Basic microbiological techniques and the application of microbiology to human beings and industry.

## Chemistry (Chem)

**1013. GENERAL CHEMISTRY.** (3 cr)
Fundamental concepts of the structure of matter. Atomic and molecular structure and chemical change. Lecture and laboratory.

**1483s. ENVIRONMENTAL POLLUTION CHEMISTRY.** (3 cr; prereq 1104 and Biol 1013 or 1104)
Quantitative and qualitative chemical determinations of pollutants and additions in water, soils, and atmosphere.

# General Agriculture (GnAg)

**1344f,w,s. CROP PROTECTION.** (4 cr; prereq Biol 1104 or #; 3 class hrs and one 2-hr lab per wk)
Principles of controlling plant diseases and insects. Insects and diseases in relation to human beings, crops, livestock, and products; habits, biology, classification, and problems of control.

**1643w,s. AGRICULTURAL CHEMICALS.** (3 cr; prereq Soil 1294, Biol 1104; 2 class hrs and one 2-hr lab per wk)
The nature and properties of agricultural chemicals primarily used as fertilizers, herbicides, insecticides, fungicides and plant regulators.

# Horticulture (Hort)

**1014. INTRODUCTORY HORTICULTURE.** (4 cr; 3 class hrs and one 2-hr lab)
Survey of the field of horticulture: environmental considerations, planting, propagation, pruning, and protection of horticultural crops. Laboratory: greenhouse and field experience.

**1114. PLANT MATERIALS.** (4 cr; prereq 1213, Biol 1014 or 1104; 3 class hrs and one 2-hr lab per wk)
The identification, ecology, and use of deciduous and evergreen trees and shrubs, vines, and selected herbaceous plants used in landscape plantings.

**1423. LANDSCAPE PRACTICES LABORATORY.** (3 cr; prereq 1014; one 2-hr lab per wk)
An applied laboratory course covering culturing requirements, pruning, spraying, digging, handling, storage, and planting of horticulture plants.

# Mechanized Agriculture Management (MAg)

**1613f,s. SOIL AND WATER ENGINEERING PRACTICES.** (3 cr; 2 class hrs, one 2-hr lab)
Engineering techniques and design in wind and water erosion control and management. Relationship of engineering factors to soil vegetation for wise utilization of basic resources.

# Natural Resources (NatR)

**1102f,w. ENVIRONMENTAL PROBLEMS.** (2 cr; prereq Biol 1104; 3 class hrs per wk)
Various aspects of environmental crises, such as population control, natural resource misuse, pesticide, urban problems, and environmental pollution. Emphasis on the role of the individual in the total environment. Current literature regarding environmental problems. Appropriate lecturers, videotapes, and films utilized.

**1223f,w. INTRODUCTION TO NATURAL RESOURCES.** (3 cr; 3 class hrs per wk)
Survey of our natural resource heritage. Various fields within natural resources examined in terms of conservation practices and importance to our way of life. Career opportunities in natural resource related fields.

**1233f,w. GENERAL FORESTRY.** (3 cr; 2 class hrs and one 2-hr lab per wk)
Survey of the field of forestry. Management of the modern forest, including conservation and recreation.

**1352s. NATIVE PLANT IDENTIFICATION.** (2 cr; prereq Biol 1214; two 2-hr labs per wk)
An introduction to principles of plant taxonomy with emphasis on higher vascular plants of Minnesota; their ecology, values to human life; and importance to wildlife as food and cover.

**1453f. PRINCIPLES OF WILDLIFE CONSERVATION.** (3 cr; prereq 1223, 1553, Biol 1104 or #; 2 class hrs and one 2-hr lab per wk)
An introduction to the field of fish and wildlife management. Fish and wildlife examined in terms of habitat requirements, population dynamics, and management practices. Public agencies and private organizations concerned with the management of these resources.

**1523w. PARK AND RECREATIONAL MANAGEMENT.** (3 cr)
Principles and techniques involved in the management of park and recreational areas, both public and private. Outdoor recreation activities and other uses of natural resources. Planning, budgeting, execution, and supervision of field maintenance and operations.

**1533s. CAMPING AND OUTDOOR RECREATION TECHNIQUES.** (3 cr; prereq 1523; 2 class hrs and one 2-hr lab per wk)
The needs of individuals involved in the pursuit of outdoor leisure activities. Familiarization with the various equipment utilized in outdoor leisure activities and experience with campcraft skills.

**1543w. SITE PLANNING AND DEVELOPMENT.** (3 cr; prereq 1523, Soil 1553, or #; 2 class hrs and one 2-hr lab per wk)
Discussion of and practice in techniques and principles of site selection; planning and development of recreational facilities for parks and campgrounds.

**1553f,s. ECOLOGY.** (3 cr; prereq Biol 1214 or 1224; 2 class hrs and one 2-hr lab per wk)
Interrelationships of plants, animals, and environment. Habitats, population, and climatic conditions present in Minnesota.

**1563s. PRINCIPLES OF FISHERIES MANAGEMENT.** (3 cr; prereq 1223, 1553, Biol 1104 or #; 2 class hrs and one 2-hr lab)
An introduction to fish and fisheries management. Aquatic ecosystems, fish identification, and principles of conservation and management. Public agencies concerned with the management of this resource.

**1652w,s. NATURAL RESOURCES SEMINAR.** (2 cr; prereq soph, 6 cr in natural resources; 2 class hrs per wk)
Current topics related to the fields of natural resource conservation and recreation. Oral reports and discussion by staff and students.

# Soil Science (Soil)

**1294f,w,s. SOIL SCIENCE.** (4 cr; prereq Chem 1104; 3 class hrs and one 2-hr lab per wk)
Formation, classification, and composition of soils with attention to the chemical and physical properties that affect growth and nutrition.

**1414f,w. SOIL FERTILITY AND PLANT NUTRITION.** (4 cr; prereq 1294; 3 class hrs and one 2-hr lab per wk)
Soil fertility as related to soil, plant, and climatic factors. Soil and plant tissue tests and interpretations.

**1553f,w. SOIL AND WATER MANAGEMENT AND CONSERVATION.** (3 cr; 3 class hrs per wk)
Management principles and practices related to production and maintenance of soil. Wind and water control techniques necessary to the conservation of soil resources stressed.

**1692s. SOIL SEMINAR.** (2 cr; prereq soph, 6 cr soil science; 2 class hrs per wk)
Studies and discussions of problems in soil. Reports on current research and topics concerning the physical and chemical problems of soil as they relate to soil fertility and soil conservation.

# VI. TECHNICAL COLLEGE, WASECA

Waseca, Minnesota 56093

CONTACT: Kathryn Hoelmer, Related Education Division, (507) 835-1000

UMW has a single mission—to prepare students for semiprofessional and mid-management positions in the broad fields related to agriculture, as well as services to rural homes and communities. In a sense, each of the programmatic areas—Agricultural Business, Agricultural Industries and Services, Agricultural Production, Animal Health Technology, Food Industry and Technology, Home and Family Services, and Horticultural Technology—and a majority of the courses are concerned with problems of environmental quality. These programs and courses deal with such areas as entomology, pathology, agronomy, animal science, food science, horticulture, soils, and mechanized agriculture.

In addition, the Related Education division, which includes such areas as the biological sciences, physical sciences, social sciences, and communications, offers courses that support and are relevant to technical agriculture. Many of the discussions in these related education courses use examples from agriculture and related problems.

## Agricultural Science (AgSc)

**1343. ECONOMIC ENTOMOLOGY.** (3 cr; prereq BiSc 1104; 4 hrs per wk)
Principles involved in controlling insects; relation of insects to humans, crops, livestock, and products; habits, biology, identification and classification.

**1443. PRINCIPLES OF PLANT PATHOLOGY.** (3 cr; prereq BiSc 1104; 4 hrs per wk)
Principles involved in controlling plant diseases; disease agents, means of propagation, life cycles, and economic implications.

## Biological Sciences (BiSc)

**1014. PRINCIPLES OF BIOLOGY.** (4 cr; 4 hrs per wk)
Introduction to biological concepts of living organisms, both plant and animal.

**1052. MAN, AGRICULTURE, AND ENVIRONMENT.** (2 cr; 3 hrs per wk)
Fundamentals of human and occupational ecology as they relate to environmental quality, with emphasis on natural resources, agricultural pollution, and population problems.

**1205. ANIMAL BIOLOGY II.** (5 cr; prereq 1105; 7 hrs per wk)
Fundamentals of animal biology; animal genetics, ecology, cell biology, and evolution of the animal kingdom.

**1215. PLANT BIOLOGY II.** (5 cr; prereq 1115; 7 hrs per wk)
Metabolic functions including photosynthesis and respiration, nutrition, water relations, and regulation of growth and development, with emphasis on the influence of environment and hormones in controlling plant metabolism.

## Horticulture (Hort)

**1323. WOODY PLANT MATERIALS.** (3 cr; prereq #; 4 hrs per wk)
Identification, adaptation, cultural characteristics and use of trees, shrubs, vines, and common landscape plants suitable for Minnesota.

**1333. HERBACEOUS PLANT MATERIALS.** (3 cr; prereq #; 4 hrs per wk)
Identification, adaptation, and cultural characteristics of annuals, perennials. Interior use of plant materials.

**1343. PLANT PROPAGATION.** (3 cr; prereq 1113 or #; 5 hrs per wk)
Principles and practices involved in propagation of plants through seeds, cuttings, grafts, layers, and divisions.

**1372. ARBORICULTURE.** (2 cr; prereq 1113; 4 hrs per wk)
Care and maintenance of trees and shrubs. Emphasis on theory and practice of wind and cavity treatment, branching and cabling, fertilizing, diagnosing tree and shrub problems.

**1443. LANDSCAPE PRACTICES.** (3 cr; prereq 1113; 5 hrs per wk)
Principles of and practices in landscape maintenance, including edging, watering, turf care, mulching, winter protection, fertilizing, and insect, weed, and disease control.

**1554. LANDSCAPE PLANNING.** (4 cr; prereq 1323 and MeAg 1024; 6 hrs per wk)
Fundamentals of landscape theory including organization of space, complementary shapes and forms, site analysis, and the relationship of structure, texture, and colors in the landscape; includes study of ornamentals and their environmental requirements.

**1634. LANDSCAPE CONSTRUCTION.** (4 cr; prereq 1554; 6 hrs per wk)
Practical assignments in planning and developing landscape sites. Drawing, sketching, introductory techniques of surveying and ground preparation; construction of formal and informal landscape carrels.

**1643. TURF MANAGEMENT.** (3 cr; prereq 1442; 5 hrs per wk)
Theory and practical application of principles in care and maintenance of turf; grass types, irrigation, fertilizers, diseases, insects, weed control, and turf equipment.

**1673. GROUNDS DEVELOPMENT AND MAINTENANCE.** (3 cr; prereq 1553; 4 hrs per wk)
Planting and maintenance of ornamental crops with emphasis on basic principles inherent to park, golf course, institutional, and estate grounds maintenance.

# Humanities (Humn)

**1423. SPECIAL PROBLEMS— MAN AND NATURE.** (3 cr; 4 hrs per wk)
The changing attitudes Americans have had toward nature, from prehistoric Native Americans to today's environmentalists. American history, painting, literature and natural history are examined for clues to the changing human relationship to nature.

# Mechanized Agriculture (MeAg)

**1404. FUNDAMENTALS OF SURVEYING.** (4 cr; 6 hrs per wk)
Principles and theory of surveying; care and use of surveying equipment; measurement of distances, elevations, angles, and directions; contours, field notes, and calculation methods.

# Soil Science (Soil)

**1054. SOIL SCIENCE.** (4 cr; prereq Chem 1104; 5 hrs per wk)
Introduction to the physical and chemical properties of the soil system. Emphasis on functions of the soil as a medium to support plant life under varying biological, chemical, and physical conditions.

**1222. SOIL AND PLANT TESTING.** (2 cr; 3 hrs per wk)
Sampling and preparation of soil and plant materials, analysis of soil and plant material in order to generate data for making recommendations, and understanding the basic research needed in making recommendations.

**1251. SOIL AND LAND EVALUATION.** (1 cr; prereq 1054; 2 hrs per wk)
Field instruction in important properties of soil and land that lead to land capability ratings and management practices needed. Soil genesis and classifications.

**1331. FERTILIZERS.** (1 cr; prereq 1054 or #; 2 hrs per wk)
Differences in the chemical and physical properties of solid, liquid, and gaseous fertilizers and other soil amendments as related to handling, formulation, and usage.

**1333. SOIL FERTILITY.** (3 cr; prereq 1054; 4 hrs per wk)
Principles involved in supplying essential elements for growing plants; effects of other growth factors, nutrient requirements of plants; deficiency symptoms, methods of application and economics of fertilizers, amendments and organic materials.

**1553. SOIL CONSERVATION AND WATER MANAGEMENT.** (3 cr; prereq 1054; 4 hrs per wk)
Principles in conservation of soil resources; relation of soil physical properties and land morphology in erosion and water problems; elementary surveying, open and tile drainage systems; contouring farm ponds, and conservation planning as applied to soil and water.

**1643. AGRICULTURAL CHEMICALS.** (3 cr; prereq Chem 1104 or #; 4 hrs per wk)
Types, properties, production, use practices, and safeguards of agricultural chemicals used as herbicides, insecticides, fungicides, and plant regulators.

# INDEX

## ALL-UNIVERSITY COUNCIL ON ENVIRONMENTAL QUALITY

Dean Abrahamson (Chairperson), Professor, Hubert H. Humphrey Institute of Public Affairs
Tom Anding (ex officio), Associate Director, Center for Urban and Regional Affairs
Perry Blackshear, Professor, Department of Mechanical Engineering
John Borchert, Professor, Department of Geography
Ken Brooks, Assistant Professor, Department of Forest Resources
Phil Buckley, Associate Professor, Agriculture Division (Crookston)
William Cunningham, Associate Professor, Department of Genetics and Cell Biology
William Fleischman, Associate Professor, Department of Sociology-Anthropology (Duluth)
Marcia Gelpe, Associate Professor, Law School
Phil Gersmehl, Associate Professor, Department of Geography
John Green, Professor, Department of Geology (Duluth)
Kathryn Hoelmer, Assistant Professor, Related Education (Waseca)
Robert Holloway, Professor, Department of Marketing and Business Law
Roger Johnson, Associate Professor, College of Education
Tim Knopp, Assistant Professor, Department of Forest Resources
John Kotar, Assistant Professor, Department of Biology (Duluth)
Lee Martin, Professor, Department of Agricultural and Applied Economics
James Moore, Assistant Professor, Department of Agricultural Engineering
Philip Raup, Professor, Department of Agricultural and Applied Economics
Ben Sexauer, Assistant Professor, Department of Agricultural and Applied Economics
Conrad Straub, Professor and Director, Environmental Health
James van Alstine, Instructor, Department of Geology (Morris)
Matt Walton, Professor and Director, Minnesota Geological Survey
Donald White, Professor, Department of Horticultural Science and Landscape Architecture